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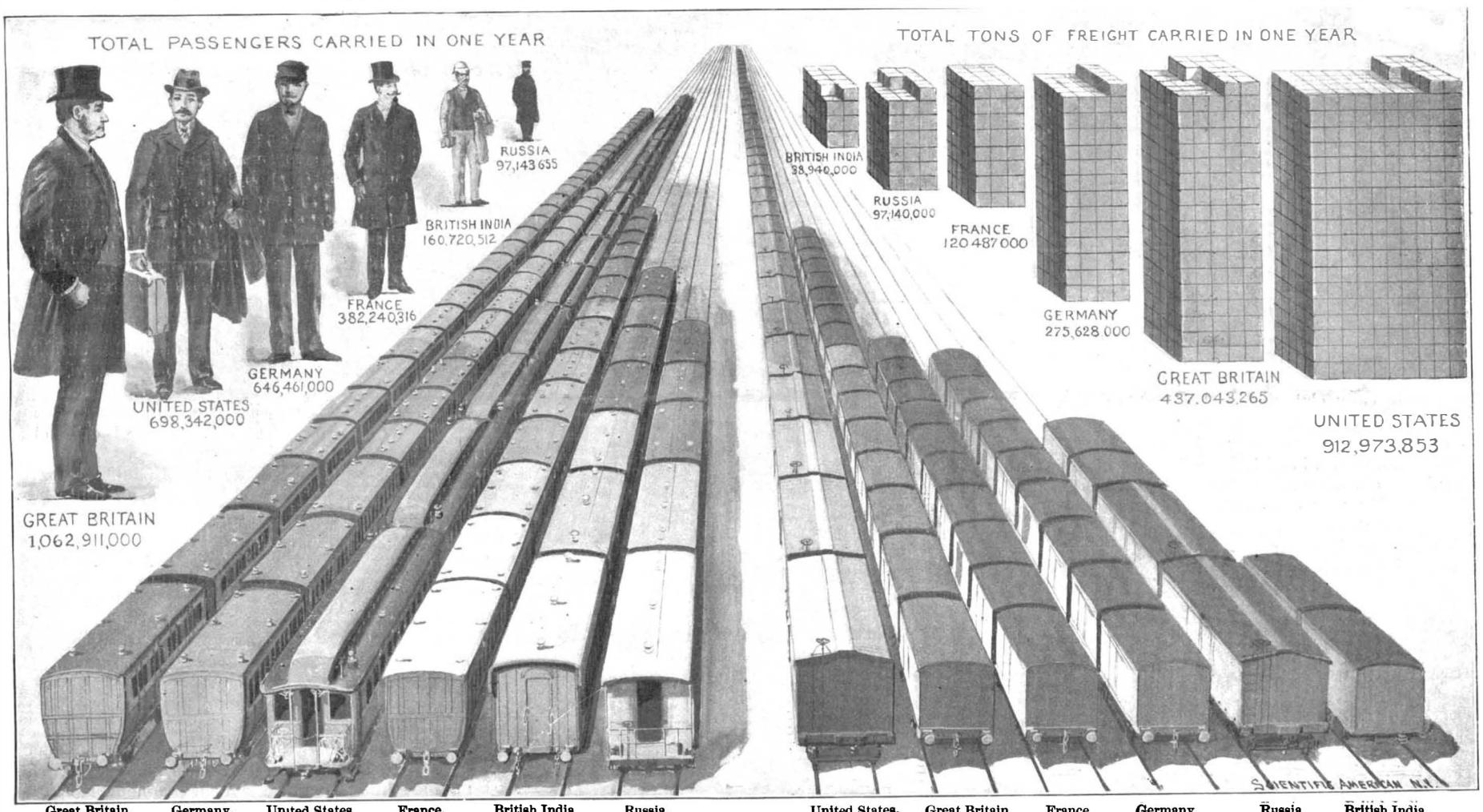

Great Britain,	Germany,	United States,	France,	British India,	Russia,	United States,	Great Britain,	France,	Germany,	Russia,	British India,
62,252	34,590	33,893	28,750	14,743	10,560	1,284,807	656,735	360,721	330,460	195,556	80,053

Total Number of Passenger Cars. Total Number of Freight Cars.

United States, 164,... miles. Germany, 29,984 miles. France, 25,862 miles. Russia in Europe, 25,357 miles. Great Britain, 23,534 miles. British India, 21,543 miles.

Magnitude of the Leading Railroad Lines of the World Represented by Size of Locomotives.

RAILWAYS OF THE WORLD COMPARED.—[See page 406.]

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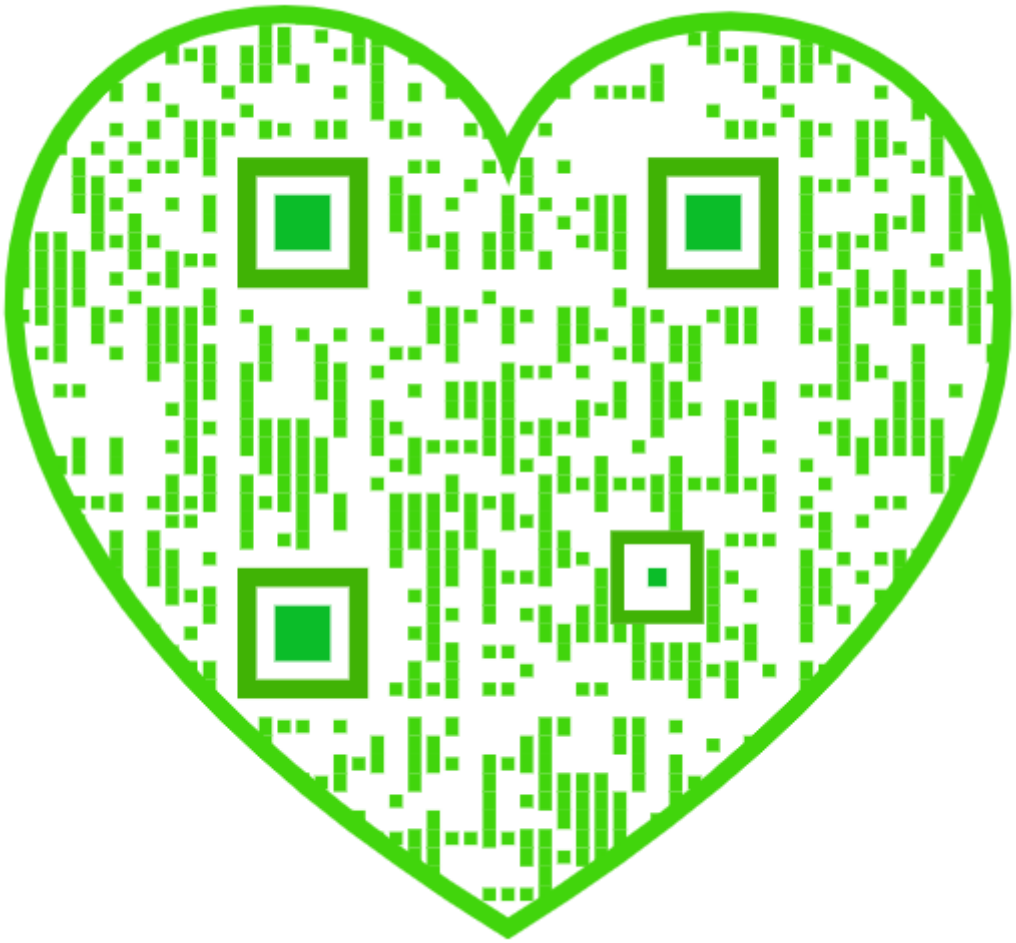

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THE END OF THE CENTURY STEAM ENGINE.

As the nineteenth century draws to a close the pen of the writer runs naturally to retrospection and comparison, and the astonishing advance which has been made in every sphere of human activity is being recorded in terms which can hardly err on the side of over-statement. Professor R. H. Thurston has recently enriched the steam engineering literature of the country by a characteristically elaborate and valuable paper, read at the last session of the American Society of Mechanical Engineers, on the steam engine at the end of the nineteenth century, in which are given the results of a careful test of a steam pumping engine of exceptional efficiency. By way of introduction, the speaker explained that the official trial of this engine exhibited such an unusually close approximation in efficiency to the Carnot cycle that arrangements were made for a scientific study of the machine as a thermodynamic engine, the tests being conducted as a part of the scientific work of the Department of Experimental Engineering of Sibley College.

It was in the first quarter of the present century that Carnot, a lieutenant of the French army, laid down the theorems of a perfect steam engine, the fundamental principle of which may be stated as follows: All heat received by the engine should be absorbed at the maximum temperature of the cycle; all heat rejected should be discharged at the minimum temperature of the cycle. The ideal Carnot elementary cycle is described by Prof. Thurston as one in which the work produced is the difference between that of expansion at constant maximum temperature and that of compression at minimum, constant, temperature; the work of compression with increasing temperature and that of expansion with decreasing temperature being means of adiabatically changing temperature between the limits of the cycle. Whether the alteration of temperature is affected by such temporary storage of energy in favor of either heat or of work, whether in a fly-wheel or in a regenerator, is unimportant, provided that all which is stored in the process of reduction of temperature is restored, by precise reversion of action, in the process of elevation of temperature.

On the question of return of heat to the boiler, the ideal feed-water heater is stated to be one which, taking heat from the expansion side of the cycle, restores it, at its own maintained temperature level, on the compression side, in such manner as to imitate, in a way and to a maximum extent, the "regenerator action," which is the ideal equivalent, economically, of the balanced expansion and compression energy transfers of the Carnot cycle. The problem is succinctly stated as follows: Could a way be found of taking out all the needed heat from the steam, between initial and back pressures, after the point of cut-off is reached, and of restoring it all, at unchanged temperature level, at the completion of the return stroke of the piston, equivalency with the Carnot cycle would be complete.

The wastes of our best engines to-day are usually not far from 20 per cent thermal and 10 per cent dynamic; whereas at the beginning of the century they were in Watt's best engines about 60 per cent thermal and 15 to 20 per cent dynamic. While the progress of the century has been mainly in the reduction of internal thermal wastes, the progress of to-day is mainly in the improvement of the thermodynamic efficiency by increasing the range of temperatures worked through, and by improving the cycle in the direction of approximation more nearly to Carnot's ideal. The outcome at the end of the century is a duty of about 160,000,000 foot-pounds per pound of pure carbon burned in the furnace of the best form of contemporary steam boiler.

The tests were carried out on a Nordberg four-cylinder, quadruple-expansion pumping engine, operating under 200 pounds steam pressure, and under a head of about 600 feet between well and reservoir, the capacity being 6,000,000 gallons per 24 hours. The efficiency measured against the perfect engine of Carnot was 84 per cent and the duty measured on a basis of 1,000,000 British thermal units was 163,000,000 foot-pounds. A comparison of these results with those obtained from other types of steam engines shows a steady and gratifying advance. Thus, a simple Corliss engine showed a duty of 93,000,000 foot-pounds per million B. T. U. supplied the engine. Compound engines show from 120 to 133,000,000 foot-pounds; triple-expansion engines, from 137 to 150,000,000 foot-pounds; while the quadruple engine under discussion has the record credit of 163,000,000 foot-pounds per million B. T. U.

A final summary of the limits of progress attained in the steam engine to date, in addition to the figures quoted, shows an economy, measured in B. T. U. per hour per horse power, of 11,160; an economy measured in B. T. U. per horse power per minute of 186; an economy in pounds of steam at 1,000 B. T. U. per hour of 11·16; and an economy of best fuel, 15,000 per pound; boiler at 80 per cent efficiency, pounds per hour of 1. The close of the century, therefore, in the opinion of the lecturer, finds the steam engine, though threatened in the view of many writers with displacement by other motors, the great motor of the age. Moreover, it has been so far perfected, and the practical limits of pressure are coming to be so nearly approached by steam boiler constructors and users, that but little more can be expected of the designer.

THE AMERICAN BRIDGE.

It is a distinct tribute to the originality of the American engineer and mechanic that so many of the forms of construction which are common to the world at large should have, when made in this country, such strong individual characteristics that they are best described by the mere prefixing of the national name. The American locomotive, the American car, the American bridge, the American buggy, the American machine-tool, are a few of the objects upon which we have stamped the national impress so deeply that they are far more strongly differentiated from similar objects, as made in Europe, than the various European types are from one another. Thus, to apply this statement to the subject of the present article, a French bridge, as far as any distinctive characteristics in its design and construction are concerned, might have been built in England, Germany, or Russia; but a European engineer coming to this country and examining a typical pin-connected truss bridge would know at once that its proportions were not determined or its parts fashioned in any European draughting office or bridge works.

The most elementary form of bridge, as represented by the plate girder, did not in the early days of American bridge building receive the attention which was bestowed upon it in Europe, where it was employed in spans of much greater length than in this country. The cause probably lay in the superior facilities for the manufacture of iron and steel plates afforded by the mills and shops of the older countries. To-day, however, we are building plate girders of over 100 feet in length, and our work in this direction is well abreast of that of the rest of the world in quality and superior to it in economy of manufacture.

For spans of much over 100 feet it becomes necessary to abandon the plate girder, economy demanding that the material of the solid plate web be concentrated in vertical and diagonal members by which the stresses will be constrained to travel back and forth between the flanges on their way to the abutments. Now it is just here, in determining the number, shapes, length, and inclination of these web members and the method of their connections, that the American truss has drawn so far away from the European type. The latter, modeled with characteristic conservatism after the plate girder, is shallow in proportion to its length, and has its material massed in heavy chords answering to the flanges of the plate girder. The web is often made up of numerous flat diagonal bars, with multiple intersections, and is known as the lattice web, which is practically a double plate web lightened by the removal of surplus material. Such a bridge with its riveted connections is costly both in material and labor, nor can its strains be calculated with the exactness which is obtainable in the type of bridge which has been evolved in this country.

When it came to designing bridges of greater length than was desirable in the form of the plate girder, American engineers, after preliminary trials of an astonishingly wide variety of types, settled down to the pin-connected truss with great depth between the chords and great width of panel. The proportions adopted were entirely scientific and represented the arrangement of metal which would give the greatest carrying capacity for the least amount of structural material. The result, as compared with the typical riveted, multiple-intersection European bridge with its ratio of depth to length of 1 to 10, was a wonderfully light, skeleton structure with a ratio of depth to length of 1 to 6, whose web material was concentrated in a few vertical posts and diagonal bars which intersected nowhere except where they met at the top and bottom chords. The substitution of the pin for rivets at the connections contributed to accuracy, facility and cheapness of construction, and of erection at the site, and enabled our engineers to put up bridges at a low cost which could not be approached by European builders. Indisputable proof of our position was given at the close of the last decade, when in a world-wide competition the contract for the great Hawkesbury Bridge in Australia was awarded to an American firm.

For spans of over 500 or 600 feet the truss is superseded by the cantilever and the braced arch. While we have erected some notable bridges of the former type, they are of course surpassed in dimensions by the huge cantilevers of the Forth Bridge with their two main spans of 1,710 feet each; although plans have been drawn for a 2,000-foot cantilever across the Hudson River at New York, which embodies the characteristic features of standard American bridge work, and would be relatively a less costly structure than the structure at the Firth of Forth. In the development of the braced arch, however, we hold the leading position, the 840-foot bridge across the Niagara Gorge being by far the largest structure of this type in existence. In this connection it should in justice to European practice be admitted that in the design of our later long-span bridges there is noticeable a tendency to reduce the extreme depth between chords, and shorten the panel width, using riveting connections more freely than in the strictly typical American construction.

It is in the design of the longest bridges, of 1500 feet span and over, that America has made its most important contribution to the art of bridge-building. The American wire-cable suspension bridge, with stiffening truss, is incomparably the most economical type, and the easiest to erect where great distances have to be bridged in a single span. Its fitness is due to the fact that its main members are subjected to purely tensile strains, and therefore require no bracing to preserve their integrity, whereas in all other systems, whether of the truss, the cantilever or the arch type, the main members must be reinforced by a mass of bracing which adds enormously to the weight and cost of the structure. The suspension cables may be assembled in the form of innumerable small wires with a tensile strength of 200,000 pounds to the inch, which is by far the strongest form into which structural steel can be fabricated. The difficulty of deformation under moving loads may be absolutely eliminated by the provision of deep stiffening girders of the kind that are to be carried by the new East River Bridge.

For a fuller study of this subject, reference is made to an illustrated lecture on Long-Span Bridges, by Prof. Burr, of Columbia College, which, commencing in the current issue of the SUPPLEMENT, will run through three successive numbers, and contain views and diagrams of the most noted long-span bridges in Europe and America.

PRE-COLUMBIAN REMAINS IN MASSACHUSETTS.

The evidences that Northmen were in Massachusetts in pre-Columbian days are derived from two sources—geography and archæology. The archæological evidence is obtained by comparing certain ruins of Massachusetts with ruins of the Saga time in Iceland, and also with the native and early European ruins on the coast of North America. The geographical evidence is found by comparing the descriptions of the country called "Vinland," in Icelandic literature, with the coast of North America. A most interesting paper on this subject was read before the Viking Club, of London, and also before the Section of Anthropology of the American Association for the Advancement of Science at the Boston meeting by Professor Horsford. Appleton's Popular Science Monthly publishes this paper, with elaborate illustrations and diagrams, in the December number, and from this source we derive our information.

The geographical data for the paper are taken from the three oldest manuscript versions of the Story of Vinland. The author then takes the descriptions given in the Icelandic texts and compares the various localities from Labrador down. Cape Cod seems to be the only cape north of Sandy Hook which corresponds with the description in the Saga, and near here we should look for Vinland. In the "Flat Island Book" it is stated the Lief Erikson's party "came to a certain island which lay north of the land." That Lief Erikson should have thought that Cape Cod was an island is excusable, because it is impossible from the Cape to see the southern shore of Massachusetts Bay, twenty miles away. The chronicle afterward says: "They sailed into that sound which lay between the island and the promontory which jutted northward from the land; they steered in west past the promontory. There was much shallow water at ebb tide, and then their ships stood up, and then it was far to look to the sea from their ship." The author of the paper then compares various localities on the New England coast which match this description. If the coast of North America should repeat the same geographical features, it would be obviously impossible to determine the site of Vinland by geography alone.

At Boston we find in the Charles River and Boston Back Bay, a river flowing through a lake into the sea, where great shallows at its mouth are a conspicuous feature, and it is "far to look to the ocean." Here then at Cambridge we can look for pre-Columbian re-

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mains. The battle with the natives is then described, which also seems to confirm the supposition that the site was near Boston. When Prof. Horsford first visited the site which his study of maps and literature had led him to believe that this locality was Vinland, he found a few hollows in the hillside and also some broad, low ridges on the level ground, indicating that a building about 66 feet long by 16 feet broad once stood there. No digging was done here until after Prof. Horsford's death, with the exception of a few trenches across the supposed site of Lief Erikson's house on the other side of the creek. In 1896, during a visit of Dr. Gudmundsson and Mr. Erlangsson, of Copenhagen and Iceland, extensive excavations were made, leaving practically nothing unexamined at this site. Three kinds of earth were revealed, black loam, yellow soil and finally clay and gravel. The ruins were at the junction of the two top layers. Throughout the black loam to the bottom were scattered fragments of china, glass, glazed pottery, pipe stems, broken bricks, etc., all belonging to the occupation of this region by the English. Two fireplaces were found, entirely unlike each other; one of these was an Indian clambake neatly paved and piled with ashes and unopened clamshells. The second was about four feet square and was surrounded by upright stones at the four corners, and it resembles the cooking fireplaces of the Icelanders. Although the outline of the walls can only be suggested, the few stones which were found at the base of the old walls were placed about five feet apart, as in the walls of the Saga-time. This, so far as it is known, is peculiar to that people and race. While this hut was being dug out, the attention of the explorers was called to stones protruding through the turf a short distance away and nearer to the water. When the earth was cleared away, it proved to be a rude, stone-laid pathway leading along the margin of the old creek to the river. Here at the landing place a similar pathway branched away in another direction, stopping suddenly near the supposed house of Thorfinn Karsefni. This pathway is called in Iceland a "path to the sea." It has a wide margin of pebbles on one side and small heaps of stone on the other. This point of land is believed to be the only one on the coast of North America which has been found to correspond with the description of the site of Thorfinn Karsefni's house. Ruins have been dug out which bear peculiar features characteristic of the period in Iceland known as the Saga-time and differing in certain essential features from the handiwork of all the native races of North America, and, as far as is known at present, from all other races in Europe or in America in post-Columbian days.

THE RECENT WELSBACH DECISION.

On the 7th instant an opinion by Judge Shipman was handed down by the United States Circuit Court of Appeals for the Second Circuit, affirming an order of the Circuit Court granting an injunction *pendente lite* against the American Incandescent Lamp Company in an action brought by the Welsbach Light Company under the Rawson patent, No. 407,963, which covers the process of coating the well known incandescent gas mantles with paraffine or other suitable material to protect them from breakage in packing or handling.

This opinion is of more than ordinary interest, since it establishes, for this circuit at least, the doctrine that in an infringement action where the invention covered by the patent was made in a foreign country, the patentee, to avoid the effect of prior use in this country, may, under certain circumstances, carry his invention back to the actual date of invention abroad. In this case the inventors filed an application for a British patent September 1, 1886, which was published July 23, 1887. The application for the patent in suit was filed in this country on August 21, 1888, and the defendant's contention was that the patent was void because Welsbach (the original inventor of the lamp) had used the Rawson process in this country prior to the date on which the British patent was published.

After reciting the facts, Judge Shipman says:

"This question arises: Can an infringer defeat letters patent of the United States to an original inventor in a foreign country by proof that a few days before the date of a prior foreign patent to the same inventor, but not before the date of the application for such patent, and less than two years before the date of the application for a United States patent, the invention was used in this country by a person who did not invent it?

"It is contended by the defendant that under Section 4886 of the Revised Statutes the Rawson patent was void, on the ground that the improvement was known and used in this country before the invention thereof, because the actual inventor is not permitted to show that the date of his invention was prior to the date of his foreign patent. . . . We are of the opinion that the language of the section refers to the actual and not an artificial date, and that where there is no contest between inventors, if knowledge in this country did not precede the actual date of the invention, unless it had been used in this country for two years before the application, the inventor was entitled to a patent. . . .

"Our conclusion is that as against an infringer the patentee in a United States patent for an invention previously made by him and patented in a foreign country may, to avoid alleged use in this country by an infringer before the date of the foreign patent, show the date of the application for the foreign patent, for the purpose of showing the actual date of his invention in a foreign country.

This summary of the Court's conclusion apparently limits the application of the decision to cases where the prior use in this country is relied upon to defeat the patent, used by an infringer, but it would seem that in this case Welsbach was called an "infringer" only because it was not affirmatively and conclusively proved that he was an original inventor of the method.

THE POLLOK LIFE-SAVING PRIZE.

A decree arranging for the international competition for the best life-saving devices in cases of disaster at sea was signed December 9 by the Commissioner-General of the Paris Exposition, M. Picard, and Ferdinand W. Peck, United States Commissioner-General. The first article provides for the opening of the competition for the best life-saving apparatus or devices for use in cases of disaster at sea. The competition will also include devices designed to save life by preventing vessels from sinking at sea as the result of collisions. All the competitors must be exhibitors in the proper class, which is "equipment for the merchant marine." It is also necessary to make a special application for participation in the competition, which application is to be addressed to the Commissioner of the country to which the competitor belongs. This must be filed before March 1, 1900. The devices may be exhibited, or working models of the same or drawings on a reduced scale will also be accepted. The competitors must explain their exhibits by full and detailed descriptions of the construction and methods employed, the dimensions and names of the parts, their weight, cost of experiments, etc. The prizes will be 100,000 francs ($20,000). The competition will be judged by an international jury, according to the rules set forth in the regulations of the Exposition. The jury will have the right to require a trial and tests, and will furnish facilities for this purpose, but all expenses connected with the trial and testing of the apparatus will have to be borne by the competitors themselves. The jury will take into consideration the value of the devices as preservers of life, not only when once in the water, but also in the case of appliances which depend upon the aid of others than those rescued, such as boats, rafts, etc. Special attention will be paid to the facilities for carrying the devices upon the vessel, their seaworthiness, durability, cost, ease of maintenance, etc. The jury may award the entire amount to one person, if they deem it of sufficient value, or the prize may be split up among two or more inventors as the jury may think best. If none of the devices presented shall be deemed by the jury of sufficient merit to justify the award of the prize, the jury may reject all, but may reimburse any competitor they deem proper. The decision of the jury will be made known to the Secretary of State of each country, and this official will attend to the payment of the sums of award by the jury. The regulations will be distributed through the Commissioners-General.

REPORT OF THE WEATHER BUREAU.

The annual report by Willis L. Moore, Chief of the Weather Bureau of the Department of Agriculture, is always filled with interesting particulars regarding the work carried on by this important branch of the government service.

The closing months of 1898 were specially stormy on the Great Lakes and the New England coast. The most severe storm in the memory of the living swept along the Massachusetts coast, November 26 and 27, causing a loss of at least 200 lives and many vessels. This appaling loss of life was mainly due to the foundering of the "Portland," which entailed the death of 150 persons. The captain of this vessel left Boston Harbor at the regular time, as he had been in the habit of doing for years, although storm signals had been flying since eleven o'clock in the morning, and marine interests had been completely notified of the coming storm. The disasters of this storm will not be soon forgotten, and the memory of it gives emphasis to the fact that the warnings of the Weather Bureau should be implicitly heeded by all mariners, for had attention been given to the danger signals, the "Portland" would be afloat to-day. The extension of the usual time limit of night forecasts from thirty-six to forty-eight hours has marked an important change in the forecast work of the Bureau. The forecast officials were directed that beginning March 1, 1899, the period covered by night forecasts should be increased to forty-eight hours. The success already attained has fully justified the issuance of the order. The new stations in the West Indian region gave important news of the great hurricane of September 10. The warnings were of the utmost value, and saved vast quantities of life and property. The Weather Bureau work on the Great Lakes has also been most successful during the year, and the storm signals kept many vessels in port and prevented many casualties and large loss of property. The success which has attended the issuance of the frost warnings during the year has also been marked, and have proved very useful to farmers, orchardists and gardeners. Among the most important cautions issued by the Weather Bureau are those which give notice to agricultural and commercial interests of the approach of abnormally low temperatures. Warnings of this class have been particularly successful during the past year, and a not unimportant feature of the advices has been the estimates of the probable continuation of this injuriously low temperature. The recognized accuracy of the temperature forecasts has caused them to be closely watched by various interests, and in the commercial centers owners of perishable goods are almost absolutely controlled by advices received by the Weather Bureau; and the special reports and newspaper comments give unquestionable evidence that the warnings prompted protective measures whereby crops, live stock, perishable goods and merchandise of the value of hundreds of thousands of dollars were saved. One warning which was issued to the truck growers in the South fifteen hours in advance of a cold wave saved $500,000.

The river and flood service did not develop any features of special interest during the year. The West Indian service is now in good running order, and the natural conservatism of the inhabitants of the several islands in the West Indies and the Spanish Main has at last been broken down, and people are beginning to realize that the warnings are of the utmost value. Many expressions of thanks and gratification have been received from the local government officials and citizens for the inauguration of the service in the West Indies, the expense of which is borne by the United States government.

A convention of Weather Bureau officials was held at Omaha, Nebraska, October, 1898, and the discussions covered a wide range of subjects, all of which had an important bearing upon the practical work of the Bureau. The exchange of views and the discussion of methods indulged in, were mutually helpful and stimulating. The convention was attended by eighty-three delegates, and a complete report containing all the papers and discussions was printed and extensively circulated. The personnel of the Bureau is kept up to its former high level and the discipline in the Bureau is admirable.

The number of deaths by lightning stroke in the calendar year 1898 was 367, and the number of injuries 494. Nine hundred and sixty-six barns, sheds, etc., 735 dwellings, stores, etc.; 95 churches and schools and 70 other buildings were struck and damaged by lightning, the approximate loss being $1,500,000. Of the buildings struck, 40 were provided with lightning rods; 855 were unprotected, and in 952 cases it could not be ascertained whether the buildings were provided with lightning rods or not. The value of stock reported killed was $48,257, and 964 head of cattle were killed.

At the close of the last fiscal year 17 kite stations were in operation, and 249 ascensions had been made, in each of which the elevation attained exceeded 1,000 feet. The work was continued until about the middle of November, 1898, at which time 1217 ascensions of 1,000 feet and over had been made. There is a steady increase in the number and excellence of meteorological papers offered for publication in the Monthly Weather Review, which is admirably edited by Professor Cleveland Abbe.

THE PROPOSED TUNNEL UNDER THE STRAITS OF GIBRALTAR.

We are in receipt of a pamphlet describing the project of M. Jean Berlier, C.E., of Paris, for an intercontinental tunnel under the Straits of Gibraltar, making a connection with the railways of Morocco. The plan is a most interesting one, although in our estimation the great cost of the same, which would be not less than $25,000,000, would hardly seem to warrant the expenditure. The amount of traffic between Spain and Morocco would necessarily be rather small at first. Africa is at present the seat of many of the most important engineering enterprises of the day, and there is no doubt that it has a great future in store for it. Morocco is an ideal winter resort, and doubtless, if it could be easily reached, would prove a competitor of Algiers or even Egypt. The building of a new tunnel and railway line would undoubtedly largely develop the French colonies. The tunnel is to have its northern terminal at Baqueros, Spain, on the Cadiz-Malaga line, to the westward of Gibraltar. The southern terminus would be at Tangier, which lies very near the west coast of Africa. The tunnel proper would be twenty miles long and the approaches would add over five miles more to the length. The pamphlet is accompanied by elaborate maps and profiles showing that the tunnel is perfectly possible from an engineering point of view. The scheme is an interesting one and should awake considerable discussion.

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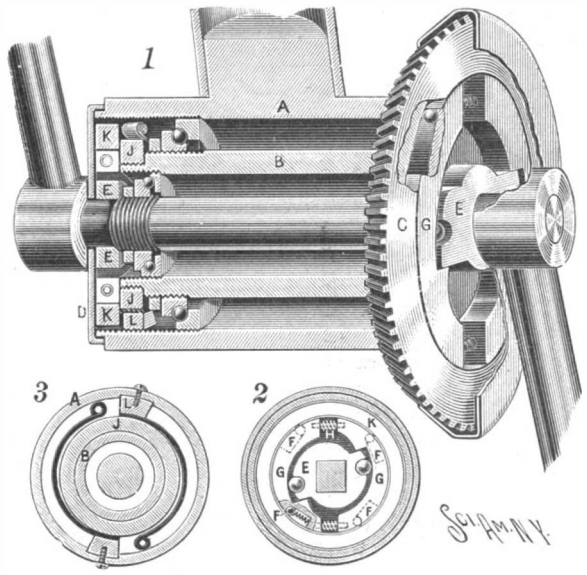
A BACK-PEDALING BRAKE FOR CHAIN AND CHAINLESS BICYCLES.

A back-pedaling brake which presents many novel features in its construction has been invented by Edgar S. Stem and Arthur O. Dunlap, of Alderson, Penn. Fig. 1 is a general view of the device. Figs. 2 and 3 are cross-sections.



A BACK-PEDALING BRAKE FOR CHAIN AND CHAINLESS BICYCLES.

The braking mechanism is applicable both to chain and chainless wheels and is contained in the crank-hanger. On suitable bearings, a sleeve, *B*, is carried, forming the trunnion for the driving gear wheel, *C*. The pedal shaft turns on bearings within the sleeve, *B*. At one end the crank-hanger is provided with a case for the gear wheel; at the other end with a cap, *D*. Near the cap end of the pedal-shaft, a cross arm, *E* (Fig. 2), is fastened, forming a clutch member, having eccentric edges terminating in shoulders, adapted to engage corresponding shoulders on shoes, *G*, likewise provided with eccentric edges. Recesses in the cross arms, *E*, contain balls for rollers designed to engage the edges of the shoes, *G*. A ring, *K*, is loosely fitted within the crank-hanger and a cam encircles the clutch member, *E*, and is held in place by the cap, *D*. When the shaft forces the shoulders of the cross arm, *E*, into engagement with the shoulders of the shoes, *G*, the shoes are turned loosely within the ring, *K*, and around with the shaft and clutch member, *E*. But when the shaft turns in the opposite direction, the rollers or balls are forced against the eccentric inner edges of the shoes, thus locking the shoes and ring together. Rigidly secured to the left end of the sleeve, *B*, is a collar, *J* (Fig. 3), against which act two brake-straps, each fastened at one end of the crank hanger by a dovetailed connection, *L*. The other ends of the straps are connected with the ring, *K*, by pins. When the ring is idle the brake-straps are loose; but when the ring is locked with the shoes, *G*, and therefore turned with the shaft, the straps will be drawn tightly against the collar, *J*.

At the gear end of the crank-hanger a somewhat similar clutch mechanism is provided. Here we also have a shouldered cross-arm, *E*, the balls of which are caused to impinge against brake shoes, *G*, held movably together as in the first case. There is, however, no loose ring. When the shoulders of the clutch, *E*, and of the shoes, *G*, are in engagement with each other, the clutch member, *E*, the shoes, and the shaft turn together. When the clutch member, *E*, is turned in the opposite direction, the rollers on the clutch member bind against the eccentric edges of the shoes and lock the gear and shoes together, so that the gear is caused to turn with the shaft. When the shaft is driven forwardly by the pedals, the clutch member, *E*, on the gear end will be caused to turn with the shaft, in the manner just described. When it is desired to coast, the pedals are held stationary, and the parts are free to run. In order to stop the machine, back pressure is applied to the pedals, so that the clutch, *E*, on the left end will throw the shoes, *G*, out against the ring, *K*, thereby causing the ring to turn, contracting the brake-straps against the collar, *J*, and stopping the motion of the sleeve, *B*, and hence of the gear, *C*.

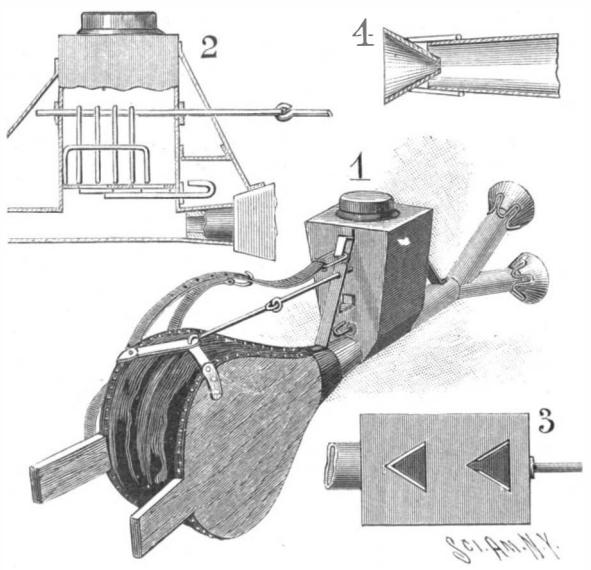
AN INSECT-POWDER DUSTER FOR PLANTS.

To provide a means for discharging insect-destroying powder upon vines and shrubs, a duster has been invented by Alfred and Thomas R. Hopper, of Highland, N. Y., which is of light construction, so that it can be easily carried about, and which is provided with a simple means for regulating the supply of powder to the discharge-tube.

Fig. 1 is a perspective view of the complete device; Fig. 2 is a longitudinal section; Fig. 3 is a cross-section; and Fig. 4 shows an equalizing nozzle employed.

The insect-powder duster is composed of a bellows communicating with a powder-chamber situated below a hopper and forming part of a discharge-tube carrying two divergent nozzles at the outer end. The hopper-bottom (Fig. 3) has triangular openings leading to the powder-chamber and controlled by triangular valve-plates, which are connected with a rod extending outwardly through an opening in a wall of the powder-chamber. By operating these valves the size of the opening can be changed to permit more or less powder to pass to the chamber. In order to break up the lumps of powder in the hopper, triangular agitators are used, the upper ends of which, as shown in Fig. 2, are connected by means of a rod with two links pivoted to opposite sides of the bellows. Hence, when the bellows are operated, the links are simultaneously given a shear-like action and the rod is reciprocated to cause the agitators to break up the powder.

The discharge nozzles are funnel-shaped, and are so mounted that a space is left between their outer surfaces and the inner faces of the discharge-tubes, so that the powder is forced both through the interior of the nozzles and along the exterior, to obtain an equal distribution. A strap is provided by means of which the device can be hung from the shoulder.



AN INSECT-POWDER DUSTER FOR PLANTS.

The construction described enables the powder to be discharged directly down or horizontally through the foliage. If insects have infested the under side of a leaf, the powder can be discharged upwardly against the contaminated surface. The shape of the nozzle tends to spread a small quantity of powder over a large surface.

AN ELECTRIC HOSE WAGON.

The fire department of the city of Paris has recently provided itself with a hose wagon propelled by electricity. This new automobile, which we illustrate herewith, and which was devised and constructed in the department's shops under the supervision of Adjutant Morvan, carries the crew and equipment necessary to fight incipient fires and save life. As the first experiments with it have been eminently successful, the city will, in a near future, be provided with similar vehicles, the use of which will have the advantage of saving time and also money, since the maintenance of the horses of the fire department costs at present at least $200 a day. The fire service of the coming Exposition will be performed by vehicles of the same nature.

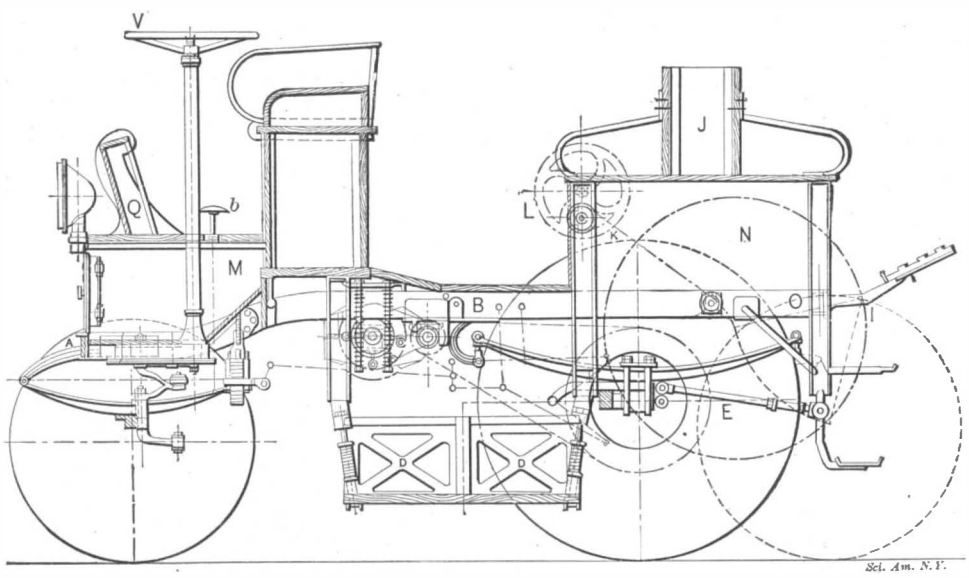


Fig. 2.—SECTION OF THE ELECTRIC HOSE WAGON.

Fig. 1.—ELECTRIC HOSE WAGON OF THE FIRE DEPARTMENT OF PARIS.

This wagon weighs, when empty, 3,830 pounds, that is to say, less than one of the electric hacks that have been running for some time past in the streets of Paris. The presence of the crew of from six to eight men and the equipment brings the weight up to about 5,275 pounds, each man being supposed to weigh 150 pounds. The box and all the motive parts are mounted upon a U-shaped steel frame, *B*, the curved front of which rests upon a compound axle through the intermedium of three springs, *A*, while the back is supported by an ordinary axle through the intermedium of a single spring. The tractive stress of the motor is exerted upon the frame through a rod, *E*, which serves at the same time as a chain stretcher.

The box is divided into two parts; upon the front seat sit two drivers, of whom the one to the right maneuvers the steering wheels through a large hand wheel, *V*, the controller by means of a small hand wheel at the side, and the pedal, *b*, of the mechanical brake by means of his foot.

The hose reel, *N*, is situated under the back part of

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the frame, of which it is independent. It consists of a drum mounted upon two wheels. Each of its extremities is provided with a journal upon which is placed a ring that on the one hand is connected with the frame by a chain, and, on the other, with a windlass through another chain. Upon actuating the windlass by means of a lateral hand wheel, *L*, the reel is raised above or lowered to the ground. In the latter case, it is separated from the wagon for the unwinding of the hose.

The box of accumulators, *D*, is suspended from the frame by four rods provided with rollers and springs. The heads of these rods move upon knife edges, so that the suspension may be very elastic and assure a perfect verticality of the box under all circumstances. The box is of metal and contains forty-four elements of C. G. S. accumulators, weighing about 1,140 pounds and having a capacity of 150 ampere-hours at a discharge of 35 amperes. The accumulator plates are of the oxide of lead type. The technical service of the department submitted to experiment various elements furnished by different French manufacturers, but the only ones that gave satisfaction were those supplied by the Société des Voitures et Accumulateurs Electriques, of Neuilly-sur-Seine. It seems that the good results given by these accumulators are due to an improved method of making the paste with which the plates are covered. The dimensions of the plates are 10½ by 5½ by ½ inches. The motor is of the T_3 type of 4,500 volts. It is provided with two armatures and two collectors upon the same shaft, but there is but one inductor winding. The two armature windings are in the proportion of five to three, and may be coupled in several different manners by the controller in order to obtain different rates of speed without changing the coupling of the elements of the battery assembled in series, or without varying the excitation. The result of this arrangement is that the motor is always excited normally and that the brushes give rise only to a minimum quantity of sparks. The flat form of the battery allows of its being installed under the box. The controller lever permits of seven speeds being obtained, the greatest of which does not exceed 13 miles an hour.

In front of the box, under the eyes of the driver, are placed the following measuring and controlling apparatus:

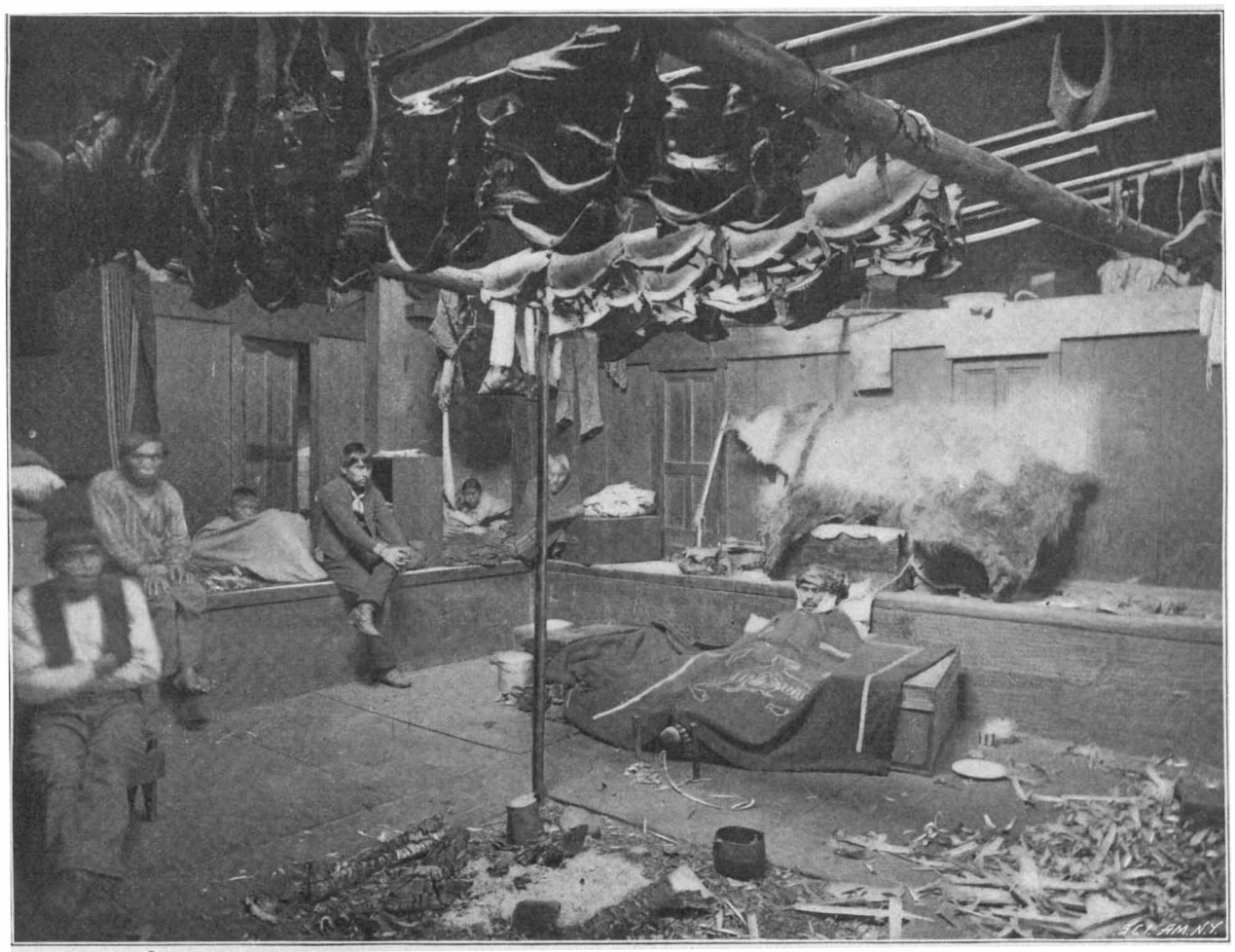
(1) An aperiodic voltmeter, (2) an aperiodic amperemeter, (3) a fusible lead circuit breaker, (4) a distributing box into which may be inserted a spring-jack connected with the charging cables, or a plug, of which the presence is necessary for the passage of the current from the battery into the motor, and which when withdrawn renders the vehicle immovable; (5) a series of interrupters controlling the incandescent lamps, lanterns, and a lamp for lighting the measuring apparatus; (6) an interrupter controlling a collector for supplying two arc lamps of 10 amperes, designed for lighting the field of operations.

The accumulators permit of making a run of 60 miles, without recharging, at a speed of from 7 to 9 miles an hour. Such speed can be easily increased to 13 miles an hour at night, when the way is clear. The consumption is, at a speed of 9 miles an hour, from 35 to 40 amperes at 90 volts. By consuming 50 amperes, 13 miles may be made upon a level. As the radius of the fire centers is 5,000 feet, on an average, from 3½ to 4½ miles would be run, provided the vehicle were called out two or three times a day. This assures of a return in good condition.

The reel at the back carries 525 feet of 2¾-inch hose, while 260 feet of a smaller diameter, along with three nozzles, are arranged in a box. The equipment is completed by a short ladder suspended at one of the sides of the wagon.

The hose carriage has received a very practical test and is now working in admirable fashion. At several fires it arrived before the engines and hose carts drawn by horses. The Fire Department of Paris has ordered six other electrically-propelled fire-extinguishing machines of different models, including a hook and ladder and steam fire engines; they will be in use at the Exposition.

For the above particulars and the engravings, we are indebted to Le Magasin Pittoresque.

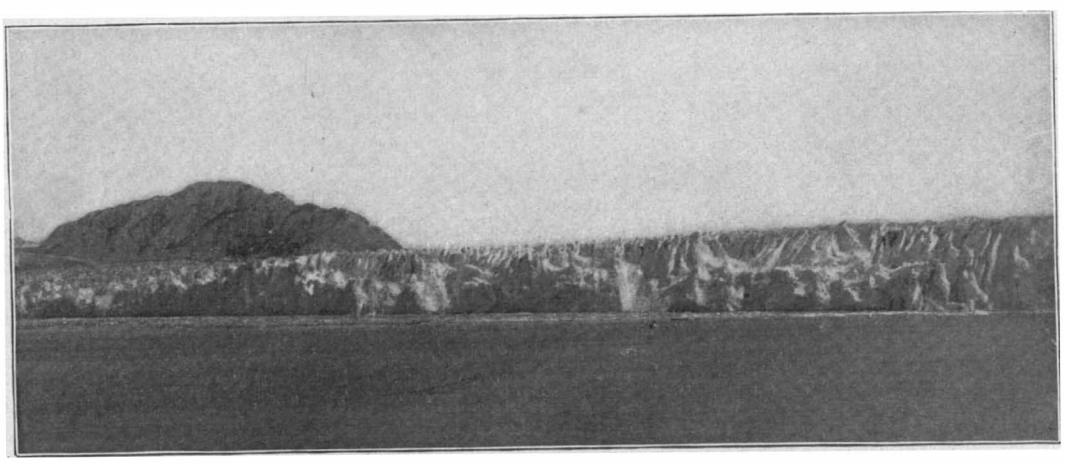


INTERIOR OF AN INDIAN HOUSE, YAKUTAT BAY, ALASKA.

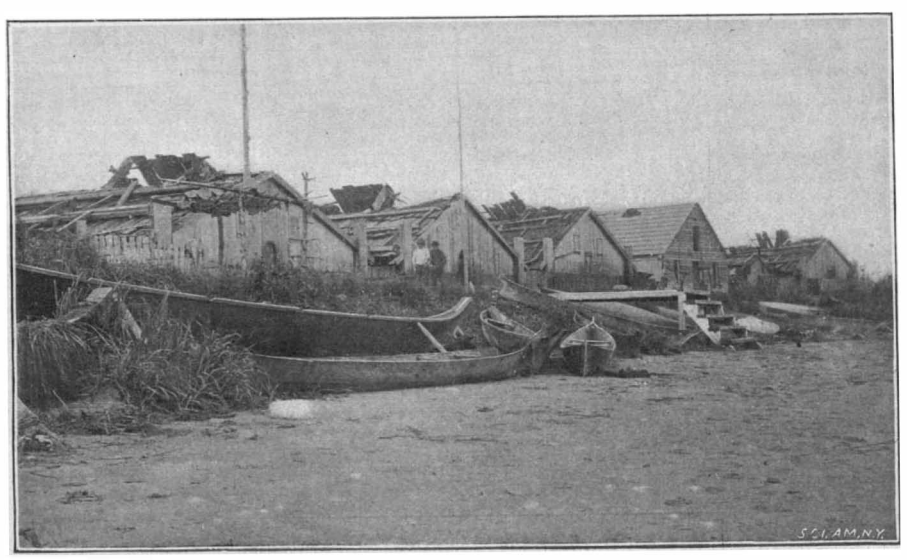
THE LATE ALASKA EARTHQUAKE.

For weeks preceding the violent volcanic eruption in the island of Hawaii, severe admonitory earthquakes were felt all along the western shores of the North American continent from the Isthmus of Panama to Puget Sound. Along the coast of California numerous shocks of uncommon severity occurred and continued until the outbreak of Mauna Loa on the morning of July 4 last, when they appeared to subside. The quietness was only temporary, however, though the scene of disturbance was transferred from equatorial to Arctic latitudes. Alaska was the theater for a display of seismic power such as the world has seldom witnessed, which, had it happened in regions less remote or had been populated by others than a few scattered bands of aborigines, would have been a catastrophe at which the world would have grown pale at the bare recital. Fortunately the dreadful upheaval had witnesses among white men, and what would have been an incident of horror to be preserved among the traditions of a few terror-stricken Indians was carefully observed by men whose probity places their recital beyond the suspicion of a doubt. The effects of the shocks were noticed far at sea by navigators, from which the enormous extent of the disturbances can be easily calculated.

The Puget Sound country was coincidently shaken, and from all accounts it would appear that with Mount St. Elias as a center the region affected by the shocks was fully four thousand miles in diameter.



THE FRONT OF THE GREAT MUIR GLACIER, ALASKA.



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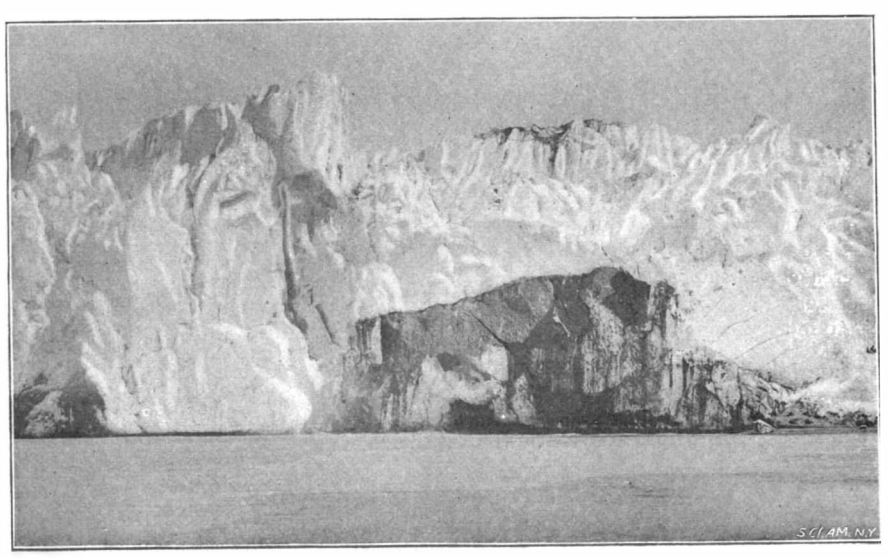
CHIEF YAN-A-TCHOO'S VILLAGE, YAKUTAT, ALASKA, SHOWING WAR CANOES.



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MOUTH OF THE SUB-GLACIAL STREAM, MUIR GLACIER, ALASKA.

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The effect has been to permanently change the contour of portions of the Alaska coast. Many well-known islands have been swallowed up and others risen in their places. Landmarks well defined and known to every navigator of the coast have disappeared, and every glacier from Juneau and vicinity, including all those known to tourists in Glacier Bay and elsewhere, have suffered mutilation, which destroyed their wondrous beauty and leveled their mighty ramparts for thousands of feet back from the sea. In the Northwest Territory volcanoes are reported to have been seen in ranges where they were never before observed. Puget Sound was violently shaken, and in the distant islands of the Alaska Archipelago severe earthquake shocks excited intense alarm. Along the coast near Mount St. Elias the upheaval was accompanied by huge and devastating waterspouts, while enormous tidal waves rushed in from the sea with overwhelming power. Great rocks fell from the sides of the mountains and crashed into the valleys below. The earth moved with the awful velocity and undulation of the waves of the sea, shaking mountains from their bases and prostrating the huge forests that covered their slopes.

The date of the earthquake was September 10, though warning shocks had been felt for some time previous. Three white men were prospecting on the shores of Disenchantment Bay, which lies at the foot of Mount St. Elias and contains the great Hubbard glacier, which has been observed only by scientists and explorers, lying, as it does, far beyond the route of tourists, and about fifty miles west of Yakutat Bay. The prospectors were camped on a ridge separating a large fresh water lake from the ocean. A violent shock threw down the obstruction, and the great flood from the lake swept down the bank, carrying the three men along with it. Concurrently, a great tidal wave swept into the bay, which washed the men back again and left them high and dry upon the side of a mountain.

They describe the oscillation of the earth as terrific, and were witnesses to the destruction of the whole front of Hubbard glacier, with its face of solid ice extending several hundred feet above the tide. For a mile from the sea the glacier was fractured and thrown in the bay. The men fled to Yakutat Bay, fifty miles distant, and reached that point after a journey beset with peril. At Yakutat Bay, Rev. Sheldon Jackson, Educational Superintendent of Alaska, happened to be visiting. He graphically describes the tremendous convulsions accompanying the shocks, the undulating shores as the earth wave swept back and forth, together with the enormous tidal waves which rushed into the bay and were engulfed in the crevasses which opened along the shores. The terror inspired among the Indians at the Yakutat Mission was unspeakable, though no lives were lost.

The most disastrous and permanent effect of the earthquake is seen among the glaciers. Foster glacier, near Juneau, has had its beauty almost destroyed. All that portion of it fronting on Taku Inlet, which the sun had sculptured into wondrous and enchanting forms, has been thrown into the sea, and rumor asserts every glacier on Glacier Bay, including the Great Muir, has suffered the same catastrophe. Tourists in Alaska can never forget their first impressions of the mighty Muir glacier. It extends landward for over forty miles, a frozen river with over twenty lateral branches. It fronts upon the sea for two miles and a half, a wall of ice from two to three hundred feet in height. Soundings give it a depth of seven hundred and fifty feet below the tide, so that from base to summit it is a thousand feet high. From this wall of ice every minute there drops into the sea 45,000 tons of ice, or every day no less than 200,000,000 cubic feet. Reports are that the whole front of the Muir glacier and extending back for a mile has been cast into the sea. Occurring at a time when the coasts of Alaska were deserted, the full effects of the earthquake will not be known until next summer permits the advance of the tourist and explorer.

The Population of London.

Last year's statistics show that the population of London is 4,484,717. For every 1,000 inhabitants there were 30 births and 17·7 deaths. The number of infants who died in their first year was 158 for every 1,000 births. During the period extending from 1887 to 1896 the mortality was lower than in Paris, Brussels, Amsterdam, Berlin, and Copenhagen; but in 1897 it increased to such an extent that it is now very little lower than that of most European cities, Rome included.

The World's Corn Crop for 1899.

The world's corn crop for 1899 is 2,611,000,000 bushels, of which the United States furnishes 2,200,000,000 bushels; Austria-Hungary furnishes 98,000,000 bushels, a serious falling off from the 153,000,000 bushels of last year. Argentina comes next with 72,000,000 bushels, then comes Italy with 68,000,000 bushels. The crop is about 111,000,000 bushels more than the average crop of the last four years.

RAILWAYS OF THE WORLD COMPARED.

If the railway statistics for the whole world were as accurately and conveniently tabulated as are those of this country, it would be a simple matter to compare the various foreign countries among themselves and with the United States. One has not delved very far into the accumulated mass of statistics which are necessary for such a comparison before he begins to appreciate, as he never did before, the excellence of the statistics of the United States, as drawn up in our own "Poor's Manual," from which it is needless to say our data, as far as the United States is concerned, have been derived. There is no annual publication devoted to the statistics of European and other railroads that professes to have the same scope and thoroughness as the work referred to. In some of the countries, owing to the delay occasioned chiefly by governmental red tape, it is rarely that one can find statistics that are brought up to within two or three years of those obtainable for the United States. The figures for foreign countries given in the present article are based largely upon the Universal Directory of Railway Officials, an excellent work in its way, which is published annually in London. The totals as drawn up from this work, however, have been verified or corrected by statistics which we have personally obtained from the proper authorities in the countries themselves.

It is a well-known fact that while comparison by numbers conveys a very adequate impression up to a certain limit, when we pass this limit the mere statement of numbers is not sufficient. Hence the popularity of comparisons which are made by graphical representation.

TOTAL LENGTH OF RAILROAD TRACKS.—The group of locomotives on the front page represents the relative length of the total amount of railroad track in the leading countries of the world. It will be seen that the United States stands at the head of the list and easily forms a class by itself, with a total mileage of 184,532 miles. The other five countries represented can only total among themselves about 126,000 miles, the United States, therefore, having 58,000 miles more than all the rest together. We must bear in mind, however, that a mere comparison by the length of the track alone does not give an accurate idea of the relative importance of the railroads. There are many other considerations involved, such as the amount of rolling stock, the number of trains that are run, the number of passengers carried, the total amount of equipment in the way of engines and cars, and the total amount of freight that is carried. When all these features are taken into consideration, we find that the position of the United States is not so commanding, although she still has a pronounced lead over all other countries.

LOCOMOTIVES.—In a comparison of the number of locomotives, the United States comes first with a total of 36,746. Great Britain comes next with 19,602, or a little over half as many. Then follow Germany with 16,842. France with 10,502. Russia with 8,748, and British India has a total of 4,258. Now, by dividing the total length of track by the number of locomotives, the reader can make for himself an interesting comparison tending to show the density of the traffic in each country, the same point being brought out, of course, by dividing the total length of track by the number of passengers carried and the total tons of freight that are hauled every year. It will be seen that Great Britain has the largest number of locomotives to a given length of track, while the United States and British India have the smallest proportion to the mile. Here again an important modification must be made; for all locomotives are by no means alike in size and power, the American engine being a far heavier and more capable machine than those of Europe. Not only is the American engine more powerful, but it is more heavily worked, and if we were to increase the totals of the United States by 50 per cent, we should get a figure which more correctly represents the motive power of this country as compared with that of the others mentioned in our table. There are no locomotives in Europe to compare with the giant freight locomotives lately built by the Schenectady or Brooks works, which weigh over 100 tons without the tender, and are capable of exerting a drawbar-pull of 22 to 25 tons, and hauling on the level a train nearly a mile in length and weighing over 5,000 tons.

CARS.—In the table of the total number of passenger cars, it will be seen that the United States ranks as third, Great Britain coming first with the enormous number of 62,252, Germany being a poor second with 34,590, and the United States third with 33,893. Here again, as in the case of the locomotives, it must be remembered that the American eight-wheel passenger car is larger and has a greater carrying capacity than the English four or six-wheel passenger coach. In length it is approximately double and in passenger-carrying capacity it is from 30 to 50 per cent larger. The absence of any platforms or a central aisle on the typical English coach enables it to carry a larger number of passengers in proportion to its length than is possible on the American car; but nevertheless it is certain that the average American car has considerably larger capacity than the average English or European coach. At the same time we must remember that American ideas are very rapidly being adopted in the equipment of English and Continental roads, and the eight and twelve-wheel corridor or central aisle type is gradually taking the place of the smaller and less convenient "carriage" of former days.

FREIGHT CARS.—In the comparison of the freight cars the United States has an enormous lead, not merely in numbers, but also in the capacity of individual cars. With a total of 1,284,807, she has about double as many as Great Britain and about four times as many as France or Germany; moreover, the average American freight car is a giant compared with the European "wagon" or "truck," for while the latter has a capacity of five to eight or ten tons, the average American freight car will run from ten to twenty tons; so that it is not stating the case too strongly to say that the total carrying capacity of all the freight cars of American railroads is from three to four times as great as that of the English "goods wagons," as they are called, and about 100 per cent greater than that of all the combined freight cars of the five foreign railroad systems included in this comparison.

PASSENGERS CARRIED.—When we come to the statistics of passenger cars, Great Britain holds a commanding lead over all other countries, with a total of 1,062,911,000 passengers carried in one year. The United States comes next with over 698,342,000, including over 183,000,000 carried annually by the steam railroads of the Manhattan Elevated Roads, New York; Germany is a good third with 646,461,000. Then there is a considerable drop, France carrying 382,240,316, followed by British India with over 160,000,000, and Russia with a total of over 97,000,000. At first sight these figures are somewhat staggering, especially when we compare Great Britain with this country, and it will naturally be asked how, with about one-eighth as many miles of track, Great Britain should carry forty-five per cent more passengers. Here again there is a qualifying factor to be considered. The length of the average passenger journey in this country is considerably greater than that of the average railway-journey in England. This is due to the vast extent of country and the great distances that are traveled in the United States. There is, moreover, a far larger proportion of the British populace dwelling in cities, and a large percentage of the city dwellers are carried to and from their work by suburban passenger trains, the amount of suburban travel in greater London alone with its five or six million inhabitants being enormous; furthermore, the liberal provision of what are known as parliamentary and workmen's trains, and the remarkably low rent at which suburban cottages may be obtained, enables the British workman to become a suburban resident to an extent that is not possible in this country. Another explanation of the enormous passenger travel in England is to be found in the large number and great popularity of cheap excursion trains, which are run during several months in the summer. Travel of this kind, which is carried largely in the United States by the magnificent system of river and shoal-water steamers, is in England taken care of almost entirely by the railroads. The facts quoted will, in a lesser degree, explain the large totals of passenger travel in relation to length of railroad track in Germany and France.

TOTAL FREIGHT CARRIED.—As we should naturally expect in a country where the provision of freight cars is so generous, the total amount of freight carried in the United States is far in advance of that of any other country, the total given in millions being for the United States, 913; for Great Britain, 437; Germany, 276; France, 120; Russia, 97; and British India, 39 million tons. A curious fact is brought out in this comparison as between the United States and Great Britain, namely, that the British freight wagon is ordinarily loaded more nearly to its full capacity than the American freight car; for although, as we stated in a preceding paragraph, the capacity of all American cars is about four times that of all English cars, the total amount of freight carried is only double as much. Just here is to be found one reason why the large capacity of the American car is not suited to the English railroad system, where consignments to particular villages and small towns frequently have a whole car reserved to themselves, so that the car may be dropped at its destination and the train proceed without any delay of unloading. The English claim that by using a smaller car the proportion of the paying load to the dead load, that is to say, of the freight to the car, is larger than it would be if the large capacity American car were used. The truth of this contention certainly seems to be borne out by the figures referred to in our table.

THE Agricultural Department will make an interesting exhibit at the Paris Exposition covering irrigation methods in the West. A government expert will have charge of the exhibit, which will include photographs, working drawings and models of irrigation plants.

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Science Notes.

M. Henri Coupon has been experimenting with the action of anæsthetics on seeds. He shows that they do not injure the grain, but the insects that attack it are destroyed. Chloroform is recommended. The grain is, however, very sensitive to anæsthetic vapors, which retard their germination or kill them.

In Siam the liquid measure used is derived from a cocoanut shell which is capable of holding 830 tamarind seeds, and 20 of these units equal a capacity of a wooden bucket. In dry measure, 830 tamarind seeds make 1 "k'anahn," and 25 "k'anahn" make 1 "sat," or bamboo basket; 80 "sat" make 1 "kwien," or cart. This is an example of the primitive origin of most units of weights and measures.

The subject of green oysters has recently awakened considerable attention. They are more highly prized by many consumers abroad than the ordinary kinds. The opinion is widespread that the greening is injurious. The Marennes oysters are harmless, however, and the color does not depend upon the presence of a particular pigment. These oysters are very popular abroad. No trace of copper or iron has been found in them.

An extraordinary floor has been laid in the London Coal Exchange. It is constructed of inlaid wood, and the pieces are arranged so as to represent the mariner's compass. Some of the slabs of wood, of which there are altogether 4,000, have interesting historical associations. Thus the one forming the haft of the dagger in the city corporation arms is a portion of a tree planted by Peter the Great when he worked as a shipwright at Deptford.

Since the first of January, 1899, up to October 31, Consul Ridgely, of Geneva, estimates that no less than 2,500,000 tourists have visited Switzerland, and that they have each left in the country an average of 80 francs, or $15.44, or a total of $38,600,000. The population of Switzerland is 2,933,300. The per capita wealth of the country has hitherto been estimated at $14, but the influx of money brought in annually brings it up to $29.45, and from one of the poorest countries per capita to one of the richest.

Within the last eighteen years 8,670,120 square miles have been added to the colonial empire of the great colonizing powers. The total, not including Egypt nor the Soudan, is as follows:

	Square miles.
Great Britain	3 987,512
France	2,936,563
Germany	1,020,070
Russia	265,381
United States	160,601
Netherlands	123,677
Portugal	96,605
Spain	79,911

According to The Medical Record, the death rate for consumption in the State of New York, for the first eight months of 1899, showed an increase over the same period in 1898 of 669. Should this rate of increase prove to have continued the remaining four months, when the statistics have been compiled, the increase in 1899 will be about 1,000 deaths, and will reach 14,000 deaths from pulmonary tuberculosis in the year, the highest rate ever known in the State. Dr. John H. Pryor favors the appropriation by the Legislature of $200,000 for establishing a State sanitarium for incipient consumptives, believing that in caring for them at the proper place and time until they are well or improved, they can be saved.

We have received the first Annual Report of the New York State College of Forestry, for 1898, which contains full information regarding the valuable work which has been carried on. A demonstration area to be set aside for the use of the College in the Adirondacks was selected by Prof. B. E. Fernow, the Director and Dean of the New York State College of Forestry, after a careful inspection of the available sites, but it has not as yet been turned over to the College. It is estimated that between 1,000,000 and 2,000,000 feet of logs, and 5,000 to 10,000 cords of wood will be the actual growth to be cut annually off the 30,000 acres. Prof. Fernow desires an appropriation of $30,000 to promote the work. It is intended to manage the property for financial results as well as for demonstration of sylvicultural methods.

It has been suggested that copper-plated zinc be used for photo-engraving. It is fully equal to copper, and the copper-plating costs very little if done on a manufacturing scale. The zinc plates are carefully cleaned with potash to remove all traces of grease and they are connected to the cathode in an alkaline depositing bath, plain copper plates forming the anode. After five minutes the plates are removed and polished with whiting. They are then transferred to an ordinary depositing bath and allowed to remain for four minutes. On removal the plates are again polished with whiting. A fish glue sensitive coating is used on the copper plates, and after development, as usual, a 40 per cent solution of ferric chloride is employed for the first etching, two minutes being allowed; the copper film being thus dissolved, the etching is continued with 3 per cent nitric acid.

Engineering Notes.

It appears from British consular reports that Morocco offers a considerable field for the engineer. There are at present no roads, railways, telegraphs, canals nor harbors.

American locomotives are used on the Bombay, Baroda and Central India Railway. The extent to which American locomotives are being used abroad does not fail to awake voices of anguish among the foreign press.

The New York Railroad Commissioners, who have been testing the efficiency of various forms of brakes for use on street railway cars, finished their tests on November 23. A report on the twenty-one devices submitted will be made public in the course of a month.

On December 9, over 160 feet of the Place de l'Etoile fell down into the Metropolitan Railway tunnel. A number of trees were also carried away. Some fear has been felt for the Arch of Triumph. It is thought that the work of the underground railway which crosses the square may endanger it.

The South Kensington Museum is constantly adding to the collection of scientific instruments and models of old-fashioned machines. We learn from Industries and Iron that they have now made a large number of additions of modern machinery and tools such as a coal gas purifying house, a Belleville boiler, a launch engine, water-tube boilers using liquid fuel, a transformer, steam turbine, etc. Many of the machine models are shown in motion.

The first Bessemer rails ever made were rolled in 1856, and analysis shows that they had the following composition: Carbon, 0·08 per cent; silicon, traces; sulphur, 0·162 per cent; phosphorus, 0·428 per cent; arsenic, traces; manganese, traces; iron, 99·33 per cent. At that time the pernicious influences of sulphur and phosphorus were not known, and as the behavior of the rails was unsatisfactory, their manufacture was abandoned, and not resumed till 1864.

An imposing monument surmounted by a bronze statue, erected to Ferdinand de Lesseps at Port Said, was unveiled on November 17. It was the work of the French sculptor M. Fremiet. It stands on a small artificial island at the entrance to the harbor, so that it comes into view immediately one approaches the roadstead. The statue is nearly 20 feet high. In one hand it holds a map of the Isthmus of Suez and with the other hand it points to the entrance of the Canal.

Locomotives were built for English railroads in 1840 in the shops of William Norris & Company, which now form a part of the Baldwin Works. Four locomotives were built to work the Lickey incline of the Birmingham and Gloucester Railway, now a part of the Midland system. The engines weighed 21,500 pounds and the drivers were 48 inches in diameter. One of the four is said to have hauled a train of loaded wagons weighing 74 tons up a grade of 2·7 per cent at a speed of 9¾ miles per hour.

There were at the close of 1896, 2,284 miles of railway owned and operated by the Swedish government. There are 7,830 persons employed during the brisk season, and the rolling stock consists of 502 locomotives, 428 baggage cars, 892 coaches, 3 dining cars, 45 postal wagons, 6 combined coaches and baggage wagons, 21 prison vans and 12,161 freight cars. It is a curious fact that 30 deer were struck by trains, while only 6 horses and 18 cows were killed and injured in the same period.

A Birmingham company of railway coach builders are now constructing a hospital train composed of seven ambulance coaches and another concern is building a number of steel-plated railway bogie vans. They are plated internally and externally with Siemens-Martin steel. While they are not strictly speaking armored cars, they are fireproof and would stand a considerable assault. The cars are painted and stained to resemble teak, the wood of which the other carriages used on the Cape lines are now made.

The army transports "Logan," "Meade" and "Thomas" are model vessels for the carrying of troops, and they have an aggregate capacity of 5,000 officers and men. The fittings on all of them are most elaborate, and on the "Logan" include folding metallic bunks, supported by steel tubes and arranged three in a tier. Shower baths and a refrigerating apparatus for preserving fresh meat for issue en route are provided. A meat-chopping machine is operated by electricity and it has a capacity of 500 pounds per hour.

Special varnish for aluminium is made by soaking 100 parts of gum arabic in 300 parts of liquid ammonia. This is heated about an hour and then allowed to cool and the varnish is ready for use. The aluminium to be coated is cleansed with soda and allowed to dry in a warm place, and after having covered the surface with the varnish it is heated in a furnace to a temperature 300° Centigrade for a short time. After covering aluminium with a coating of this varnish, it can be painted and polished without any fear of scaling off or cracking.

Electrical Notes.

The Baltimore Fire Department is to have a search light similar to the ones which are being made for New York for use in fires.

Abyssinia has a telephone line 300 miles long connecting the capital and the important city. It was constructed by a Franco-Russian company.

The largest stationary steam turbines in the world are being built by the firm of C. A. Parsons & Company, for a municipal lighting plant at Elberfeld, Germany. They are 1,400 horse power each.

Ten thousand horse power will be transmitted from Garvin's Falls, fifteen miles from Manchester, N. H., to that city for lighting, power and street railway business. The water power is one of the finest in New England, and the new enterprise can hardly fail to be successful.

Twenty-five fire alarm boxes have been put into use in New York city as an experiment, and if their operation proves successful the same apparatus will be generally adopted. The boxes are arranged so that two or more alarms may be sent simultaneously over the same circuit without causing confusion, and each alarm will be recorded at fire headquarters. With the present system, when two alarms are sent in over the same circuit, confusion and delay often result.

An American company has been awarded the contract for the supply of all the trolley, feed and span wires for the equipment of the lines of the Havana Railway Company. The concession to convert the principal existing horse and steam tramways in Havana into electrically-equipped roads has also been granted. There are 54 miles of road in all. The feed wire will cost not less than $200,000. It will be the largest export contract for electrical wire ever placed in this country; 2,200 iron trolley poles have been ordered at a cost of $85,000. According to The American Exporter, the Havana company has also ordered sixty carloads of terra cotta conduit in this country.

Wireless telegraphic communication will be established between five of the Hawaiian islands by an American company. Although many engineers regarded the connection of the five islands by cable as impracticable on account of the coral reefs, an American company had, says The Electrician, about decided to attempt it, as the needs of telegraphic communication had grown most urgent. On hearing of the remarkable success of the Marconi system, the company investigated it and found that it would cost much less and be more practical in many ways than a cable. A regular telegraph business will be done by the company, installing the wireless system. The distance over which communication will be established will vary from 8 to 61 miles.

A correspondent of The American Electrician recently made use of some telephone apparatus for an alarm system. A bank vault was connected with a room of one of the officials in the same building, so that anyone attempting to enter when the switches were on would turn in an alarm. In the vault is a very sensitive telephone transmitter, the primary current of which is controlled from the receiving end. At the receiving end is a complete telephone and the necessary switches. When an alarm comes in, the person at the receiving end allows the current to pass through the primary of the induction coil of the vault transmitter and with his receiver can hear distinctly the slightest noise in or near the vault. With the aid of this system it is positively known if the vault is being tampered with before the police are summoned.

The ordinary method for the preparation of chromic acid to be utilized as oxidizing agent is the following, says The Trade Journals Review. Chromium sulphate is decomposed with lime, and the resulting paste of lime, gypsum, and chromium oxide heated to red glow. The chromate of lime thus formed is treated with sodium sulphate, which yields soluble sodium chromate and gypsum. To liberate the chromic acid we have again to add sulphuric acid, which is bound by the lime, yielding more valueless gypsum. In several electrolytic processes the chromium salt is treated with caustic soda; but the electrolysis again yields sodium chromate, so that both the soda and the sulphuric acid are practically wasted. The Farbwerke, late Meister, Lucius and Brüning, have now worked out, on a large scale already, a new, less wasteful process. They start from a solution of chromium sulphate in sulphuric acid and fill both the anode and the cathode compartments with that solution. On the anode, chromic acid is liberated, on the cathode, hydrogen; in the former compartment the sulphuric acid concentration increases, in the latter it decreases. The anode lye can at once be employed for oxidation; during that reaction it is reduced to chromic oxide, which is returned to the cathode compartment, while the former cathode lye is transferred into the anode chamber. Thus a continuous process takes place. The decomposition requires 3·5 volts and a current density of 300 amperes per square meter. The electrodes are of lead, and the temperature of the cells is raised to 50° Cent.

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JOSEPH HENRY.

BY CUYLER REYNOLDS.

Owing to Joseph Henry's position in the history of American science, it has been deemed advisable by the citizens of Albany fittingly to celebrate the anniversary

JOSEPH HENRY.

of his birth on December 17, as he was born in that city one hundred and two years ago. A few years from now all evidence will be either hearsay or that which is contained in books. To-day there live a few who recall him as he was far back in the century, when as a vigorous young man with residence in Albany, N. Y., he astonished the world by the success of some of his greatest works.

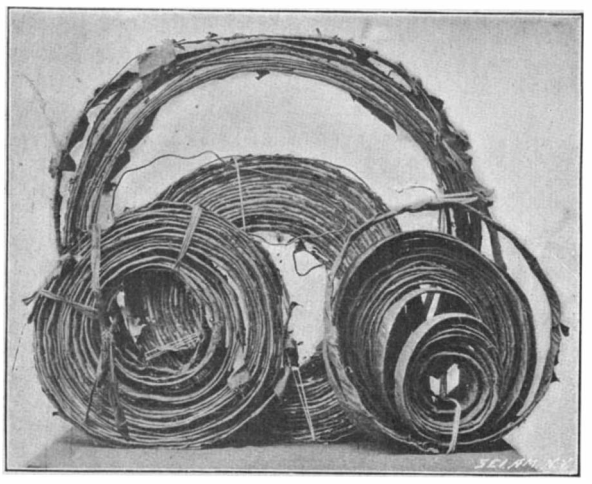
Few men of his time have been so active as was Henry during three quarters of a century. When contemplating the long list of inventions, most of them world famous, placed to his credit, it is cause for wonder, intermingled with admiration, that one man was able to do so much and do that remarkably well. Faraday's experiments in electricity established his name, never to be erased from the roll of great men; but one finds in reviewing the life-work of Henry equally as many and as valuable inventions, or more properly speaking additions to the sum total of scientific knowledge of the world, the product of a wonderfully organized mind. There were bright minds here and there, in Great Britain, France, Germany and Italy, at work upon similar lines of scientific development. Each made discoveries of great value, but the sense of satisfaction must be great to-day to every American to read that Henry antedated each of them. They worked until they produced something new, but Henry was like the combination of all of them, and, moreover, preceded them in each case. A report coming from Europe, by slow process in those days when there was limited interchange of thoughts between two continents, of some striking invention would be met by the printed paper on the same subject from Henry, showing that none could equal him in his march.

Prof. Joseph Henry was born in Albany, N. Y., December 17, 1797, and spent the greater part of the first thirty-five years of his life there. It was there that he attended school, in the Albany Academy, organized in 1813, being one of the 92 pupils first enrolled. His grandparents on both sides came to this country from Scotland, landing on June 16, 1775, the day before the battle of Bunker's Hill. When seven years old he went to Galway, Saratoga County, to reside with his maternal grandmother, and he continued there some time, as his father died before he could make any other arrangements for young Henry's future. He was sent to the district school, where Israel Phelps was master, and at ten entered the service of Mr. Broderick in his village store, but through the latter's kindness was allowed to attend afternoon sessions of the school.

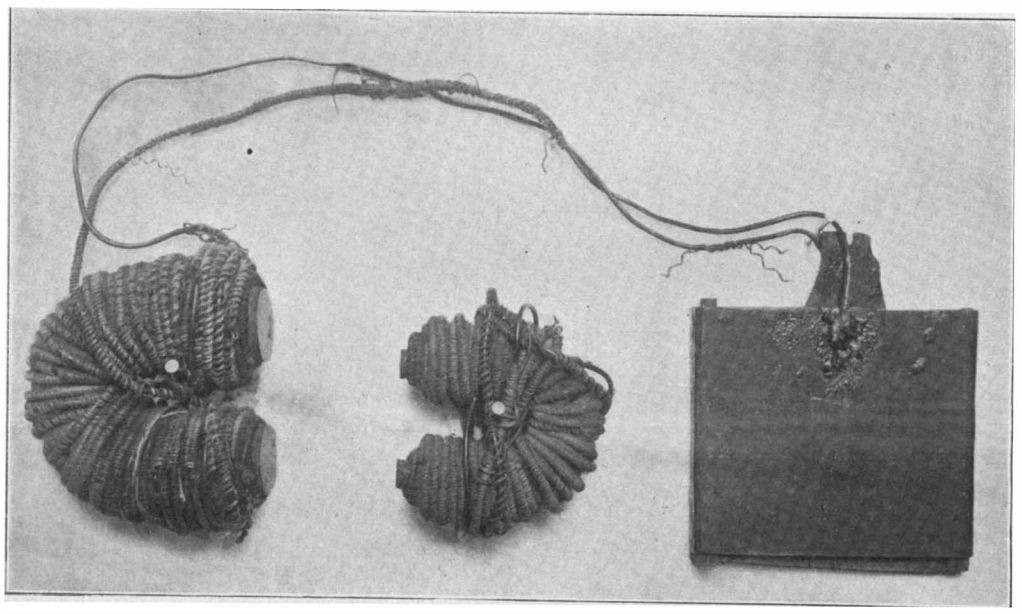
When fifteen years of age he returned to Albany to enter a watchmaker's shop. Strange as it may seem to those who realize how modest and retiring was his character in later years, he shortly gave way to the inclination, aroused by attending his first play on a visit to Albany, and cast his lot with theatrical people. For this he spent all his spare money and became an expert in preparing stage mechanism. Perhaps this was but a second stepping-stone toward the combining of materials in scientific instruments. He joined the private theatrical association in Albany styled "The Rostrum," and the originality of his scientific effects gained somewhat of a reputation for him. When the watchmaker left Albany young Henry had free rein to follow his vocation, dramatized a tale and produced a comedy. What a contrast to his other papers for fifty years after! A second accident, but this a physical one, confined him to the house, where he continued his acquaintance with books. These were philosophical works which he took up, and they produced a train of thought that effaced recollection of the stage. It was then the serious thinking of his life commenced and marked his coming to the Academy as an advanced student under Dr. T. Romeyn Beck; but he was obliged to pay his way by teaching in a district school. Then he became an assistant in the Academy, and again a private tutor in the family of Gen. Stephen Van Rensselaer. In 1826 he was engaged in a surveying expedition under the State, and laid out a road through the southern counties. Had the appropriation for continuing similar work passed, Henry might have continued as a successful surveyor; but it did not, and this brought him to the turn in the road again that led to success as a scientist. The vacant chair in mathematics and natural philosophy in the Academy offered was accepted, and his researches dated from that time. He associated himself with the Albany Institute while a tutor in Gen. Van Rensselaer's family, the latter being the president of the Institute, and Henry's first paper, presented October 30, 1824, when he was 26 years old, was: "On the Chemical and Mechanical Effects of Steam." He illustrated this by apparatus prepared by himself. He demonstrated a striking paradox, that the jet of steam will not scald the hand at a prescribed near distance from the jet, provided the steam be sufficiently hot.

Prof. Henry's home was No. 105 Columbia Street. The location is within sight of the new Capitol, perhaps 300 yards distant. It struggled hard apparently to survive its century of usefulness, for the old house was torn down this centennial year after appearing for ten years in most dangerous condition.

Among Henry's early friends were Hon. George W Carpenter, Dr. Philip Ten Eyck, Thomas Hun, M.D., and Orlando Meads. Carpenter was at first a student under him, then, in 1828, when seventeen years old, first assistant engineer in the United States service, and in 1830 a tutor in the Academy. He not only helped in preparation of the apparatus for the test of the telegraph, but was one of that select group present when the demonstration was made. Mr. Carpenter is still living, and resides in Albany; sound in body and in mind, although in his eigthy-ninth year. He states from personal knowledge that it was in the northwest corner of the basement of the Academy that Henry had his laboratory. The first experiments, however, were conducted in a room up stairs. The wire was strung about the ceiling of this room, and in one window was placed the apparatus, consisting of magnet and small bell. Many wrongfully suppose, from historical accounts, that it was the tinkling of this bell that thrilled the audience, certainly a gathering not appreciative of what was being manifested, but the bell itself did not move. It has a brass clapper, but the sound was produced by the striking of a steel rod against it. This little bell that played so important a role is now owned by Miss Caroline Ten Eyck, of Albany.



INDUCTION COILS USED BY HENRY TO INVESTIGATE THE DISCHARGE OF LEYDEN JARS. PRINCETON UNIVERSITY MUSEUM.



THE FIRST MAGNETS WITH SEVERAL LAYERS OF INSULATED WIRE, 1828.

This bell measures 1⅝ inches in height, and 1¾ inches in width at the mouth. It served as a part of a sounder, and as Mr. E. N. Dickerson remarked some years later in a lawsuit, "the thing was perfect as it came from its author, and it has never been improved from that day to this as a sounding telegraph." More striking still was the remark that the idea of Morse of impressing an alphabet upon strips of paper was abandoned, and people have gone back to the way Henry demonstrated it in the Academy that day, reading the signals by sound. This test was made in 1830. What led up to this discovery was his experiment with magnets. He commenced the study in 1828, exhibiting before the Albany Institute a small-sized electro-magnet closely wound with silk-covered copper wire (see engraving). The former plan had been to insulate the bar or core. By his compact method he obtained more turns, which were also more nearly at right angles with the magnetic axis, and thereby gained greater power. To Henry the world is indebted for having first constructed the magnetic "bobbin" which has come into universal use in electro-magnetism. In 1830, assisted by

PROF. HENRY'S HOME IN ALBANY, 1832, RECENTLY DEMOLISHED.

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Dr. Ten Eyck, he tried larger bars of soft iron, and about one he wound 540 feet of copper wire in nine coils of 60 feet each, which coils surrounded the branches of the horseshoe. By properly connecting the pairs of wires he obtained a wonderful increase in power. This magnet was suspended in a rectangular wooden frame. The lifting power was 650 pounds and only a single battery was used, consisting of two concentric copper cylinders with zinc between, the zinc surface measuring only $\frac{2}{5}$ of a square foot, with only a half pint of dilute acid.

Evidently Henry was aroused to make researches by

BELL USED IN THE FIRST TELEGRAPH EXPERIMENT, 1830. ACTUAL SIZE.

the strong desire to expound before his class more than was contained in the text books. The late Prof. James Hall, the renowned geologist, attests what has been said about the invention of the telegraph from his own experience, in the following words, after describing the arrangement of the circuit:

"And at one termination of this, in the recess of a window, a bell was fixed, while the other extremity was connected with a galvanic apparatus. You showed me the manner in which the bell could be made to ring by a current of electricity transmitted through this wire, and you remarked that this method might be adopted for giving signals by the ringing of a bell at a distance of many miles from the point of its connection with the galvanic apparatus."

It is entirely unnecessary to indulge in discussion of the precedence of the Henry and Morse early developments of the telegraph, for the matter was decided by a committee of the Smithsonian Institution, whose business it was to investigate and which determined that Henry was the originator, and more forceful even than this is what Morse said regarding how he commenced his experiments three years later than Henry's practical demonstration.

Morse's telegraphic apparatus lacked the powerful magnets that Henry invented. It was shown in court that his invention, embracing his system, would have failed had not Henry's invention in this line helped him to surmount the difficulty. Morse, having worked out a practical telegraphic system, has been given credit in the popular mind for the whole, but the work accomplished by Henry made it possible for Morse to render his system practicable. In spite of the rivalry between the two inventors and all that was said at the time in disputing the claims of priority for the two by their supporters, Henry brightened Morse's darkest hours, between 1839 and 1843, by encouraging him, which goes to prove that Henry was satisfied with discovery, and was only too glad that others might benefit pecuniarily. The letter that Henry wrote to Morse refers to a prospective test of the latter's invention in practice by a line of forty miles, connecting Baltimore with Washington:

"Princeton College, February 24, 1842.

"My Dear Sir: I am pleased to learn that you have again petitioned Congress in reference to your telegraph; and I most sincerely hope you will succeed in convincing our Representatives of the importance of the invention. . . . Science is now fully ripe for this application, and I have not the least doubt, if proper means be afforded, of the perfect success of the invention. With my best wishes for your success, I remain with much esteem, Yours truly,

"Joseph Henry."

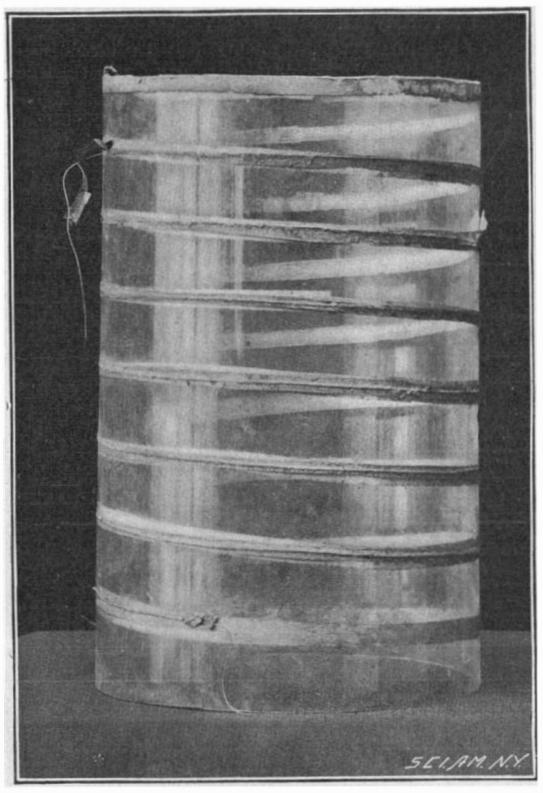
In December, 1842, the sum of $30,000 was appropriated, passing the House of Representatives on February 23, 1843, and the Senate on March 3. The four wires were extended, and on May 24, 1844, the first message was sent. The success led to many inventions all over the country, and they to many lawsuits brought by and against Morse. These brought out the priority of claims, and rivalry between Morse and Henry was engendered. Henry was defended by the Regents of the Smithsonian Institution, who certified to the priority of Henry's researches and indorsed his claims, which were:

"1. Previous to my investigations, the means of developing magnetism in soft iron were imperfectly understood, and the electro-magnet which then existed was inapplicable to the transmission of power to a distance. 2. I was the first to prove by actual experiment that in order to develop magnetic power at a distance, a galvanic battery of intensity must be employed to project the current through the long conductor, and that a magnet surrounded by many turns of one long wire may be used to receive the current. 3. I was the first actually to magnetize a piece of iron at a distance, and to call attention to the fact of the applicability of my experiments to the telegraph. 4. I was the first to actually sound a bell at a distance by means of the electro-magnet. 5. The principles I had developed were applied by Dr. Gale to render Morse's machine effective at a distance. The results here given were among my earliest experiments, in a scientific point of view considered then of much less importance than what I subsequently accomplished; and had I not been called upon to give my testimony in regard to them, I would have suffered them to remain without calling public attention to them, a part of the history of science to be judged of by scientific men, who are the best qualified to pronounce upon their merits." (Smithsonian Report for 1857.)

It was Henry who explained the difference between "intensity" and "quantity" to Morse, and L. D. Gale testified that he saw the imperfection in Morse's work and advised him that—

"The sparseness of the wires in the magnet coils and the use of the single cup battery were to me, on the first look at the instrument, obvious marks of defect, and I accordingly suggested to the professor, without giving my reasons for so doing, that a battery of many pairs should be substituted for that of a single pair, and that the coil on each arm of the magnet should be increased to many hundred turns each; which experiment, if I remember aright, was made on the same day with a battery and wire on hand, furnished, I believe, by myself, and it was found that while the original arrangement would only send the electric current through a few feet of wire, say 15 to 40, the modified arrangement would send it through as many hundred. Although I gave no reasons at the time to Prof. Morse for the suggestions I had proposed in modifying the arrangement of the machine, I did so afterward, and referred in my explanation to the paper of Prof. Henry in the 19th volume of the American Journal of Science, page 400 and onward. . . . At the same time I gave the suggestions above named, Prof. Morse was not familiar with the then existing state of the science of electro-magnetism. Had he been so, or had he read and appreciated the paper of Henry, the suggestions made by me would naturally have occurred to his mind as they did to my own. . . . Prof. Morse professed great surprise at the contents of the paper when I showed it to him."

There is no question regarding the serious handicap placed on Henry's labors through lack of funds. This did not so much affect the needful purchases for science, which were, however, a tax; but cramped the time which he could devote to research. In both ways the remedy was advantageously found in one who was his most intimate friend during the time that he was working in the Albany Academy. This man was Dr. Philip Ten Eyck. The friend relieved Henry of the labor of making many of the parts of the now famous telegraph machine, supplying them from his own purse and contributing to Henry's curtailed time by working in the basement while Henry attended to his classes on the main floor above. So indefatigable was Dr. Ten Eyck in collaboration with Henry that it would be negligence whenever speaking of the work of those days and the invention of the telegraph to omit his name; and though much thought in solving the wonderful problem came from the former, the doctor friend never uttered any detraction from the fame of Henry. The participation of Ten Eyck was so prominent and is made to appear so authentic from many sources that the two names must continue to be interwoven in the



JAR, WITH TINFOIL SPIRAL, USED BY HENRY TO PROVE THE INDUCTION OF THE STATIC DISCHARGE. PRINCETON MUSEUM.

telling of what was done. Dr. Ten Eyck was selected to take Prof. Henry's place when he resigned in November, 1832, to accept the professorship of natural philosophy in the College of New Jersey at Princeton.

"In 1837 Prof. Henry visited Europe, the object of this trip, as stated in his own words, being: 1. The formation of personal acquaintance with men of science which may be the basis of future correspondence on scientific subjects. 2. The study of the modes of instruction in science. 3. The methods of making original researches in the different branches of science. In short, to make such attainments as may be useful either in the way of my duties as an instructor or in reference to my own researches and which cannot be obtained from books.

"As I feel considerable strength on some subjects of science, I shall not be ashamed to show my ignorance on others by asking questions even of an elementary nature."

While in Europe he had many delightful interviews with Faraday, profitable and pleasurable conversations to both. With Wheatstone, who was then professor of experimental philosophy in King's College, he talked of magnetic circuits. In Paris he met Gay-Lussac, Arago, Biot, Becquerel, and De la Rive, and on his travels Dr. A. Dallas Bache (died 1867) proved a valued companion. Dr. Bache's father, Richard, was a son of the only daughter of Benjamin Franklin. At Paris Henry was unable to speak the language, but he met there, studying medicine in the Latin Quarter, Thomas Hun, M.D., of Albany (1808 — June 3, 1896), whom he knew well at the Academy, and he acted as an interpreter. To this day it is quoted that Hun, although a prominent physician, was proud to style himself "Mouthpiece of his Majesty."

Henry was ever weighing his moments, that he might yield the greatest profit to science. Strangely indeed, while he knew he had remarkable ability, it cannot be pointed out that he ever so declared himself vauntingly.

He was obliged to earn a livelihood, and this he considered as a millstone. It was, during the early years of his life, like so much work before play, his play being deeper work than ever. When new positions were offered to him, he did not think what advancement in fame attached to them or what the financial gain might be, but only how much time he would have for his precious researches after he had each day fulfilled the quota of work to supply the body with food. If the new position might place him in ease, yet rob him of hours for scientific study, he could not see how he should better himself by accepting the offer.

Even at so youthful an age as

MAGNETIC APPARATUS MADE BY HENRY, NOW IN THE SMITHSONIAN INSTITUTION.

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that of his election to fill the chair of Natural Philosophy at Princeton (November, 1832, aged 35), he was regarded as the leading man of science in America. Prof. Benjamin Silliman, of Yale, in urging his appointment wrote: "Henry has no superior among the scientific men of the country;" and Prof. James Renwick, of Columbia, added: "He has no equal." It is needless to say his election was unanimous and Princeton was the gainer. So varied was his learning that in 1833, while Dr. Torrey was in Europe, Prof. Henry filled his chair of chemistry, mineralogy and geology, and subsequently he lectured on astronomy and architecture.

Here he even found time to make researches in the college laboratory, constructing an original form of galvanic battery, so arranged as to bring into action any desired number of elements, from a single pair to eighty-eight.

His studies brought about discoveries in electrical self-induction, combined circuits, oscillation of electrical discharge, on "a simple method of protecting from lightning, buildings covered with metallic roofs," molecular physics, simple forms of heliostat, phosphorogenic emanation, relative heat-radiating power of solar spots, phenomena of fluorescence, electricity obtained from a small ball filled with water and heated by a lamp, new method of determining the velocity of projectiles, sonorous flames passing into a stove pipe, flow of water jets under varying conditions, relative angle of vision formed by a moving body, organic dynamics, derivation of species and affiliation of specific forms, limit of perceptibility of a direct and reflected sound, the thermal telescope, electric engine, which was the forerunner of the great principle we now enjoy so extensively in the motors of various kinds.

The Act of Congress, approved August 10, 1846, established the Smithsonian Institution for promotion of science, employing the liberal bequest of James Smithson, of London. Henry was made its first secretary, December 3, 1846, and actual director. He was afraid that his duty to the Institution would prevent him from making further research as at Princeton, and he questioned whether: "If I go, I shall probably exchange permanent fame for transient reputation," meaning that fame signified material gain for the scientific world. But he found the work so compatible with his ideas that in 1847 he declined a call to the Professorship of Chemistry in the Medical Department of the University of Pennsylvania, despite the urging of his friend Dr. Robert Hare and the salary, more than double that he was receiving at Washington.

He brought his scientific service to the use of the light-house board, geological, meteorological departments, and aided in establishing observatories. How he could find the time, it is hard to say.

Late in life (1875–77) as chairman of the committee of experiments of the United States Light-House Board, he conducted half a hundred experiments, and some of the nature that reasonably lead one to suppose that had he continued to live a little longer, he, with his mind well furnished with electrical data, would have given us the wireless telegraph. Through his efforts he secured to the government the free use of the Atlantic cable for transmission of important dispatches regarding astronomical discoveries, and the Royal Geographical Society passed a resolution of thanks in recognition of the good service. London also honored him in the "freedom of the city" on his visit, and three steamship companies asked the privilege of conferring free transportation.

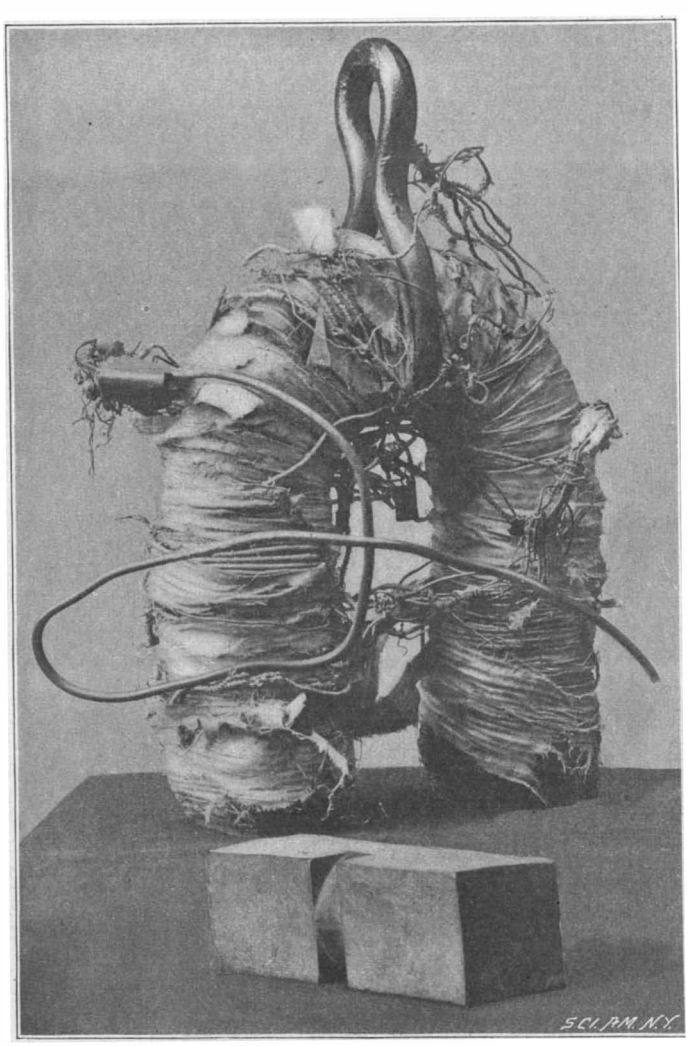
Joseph Henry died May 13, 1878. Fitting memorial exercises were held in the hall of the House of Representatives, Vice President Wheeler presiding, and addresses were given by several prominent men.

California Fig Culture.

Although California has often been called the land of the orange and the fig, there have been, in fact, very few figs grown in the State, and these have been of a poor quality. According to The New York Evening Post, from which we glean our facts, more than sixty varieties have been, from time to time, introduced from various parts of the world and carefully nurtured and planted at the experiment stations, only to demonstrate that they would not bear in the United States, or at least in California. Only the White Adriatic and the Black Mission are relied upon to produce crops. The Mission fig, like the Mission grape, was introduced from Spain by the early Franciscan friars, and their successors have been able to add only one species to the fig culture in California, and that is the White Adriatic. Neither of these figs is very satisfactory, and they do not offer much competition to the Smyrna fig, the importations of which amount to $2,000,000 per annum in value. Cuttings of Smyrna figs were brought into the State direct from Smyrna in the latter part of the eighties, and the cultivation of the fig was attempted without the aid of the fly called "blastophaga," which assists in the maturing of the figs.

The fig industry continued to be a failure until the Agricultural Department at Washington sent Mr. Walter T. Swingle to the countries bordering on the Mediterranean to look up the industry to see what was needed to make a success in California. He came to the conclusion that the blastophaga was the true means for the successful cultivation of figs, and he sent some 300 caprifigs (the uncultivated male fig) each fruit containing many of the blastophaga. They were wrapped in ten different packages of thirty each and were sent at different seasons of the year. Most of these shipments arrived safely at a fig ranch in Fresno and were at once hung up on various fig trees. In due time the flies hatched out and proceeded to enter the Smyrna figs, or rather the figs on the trees grown from cuttings which were imported from Smyrna. The result is there will be this year for the first time in the history of the State, a full crop of Smyrna figs. The caprification is necessary to the maturing of the fig, as can be proved. At Smyrna the people gather the caprifigs, which grow wild in the mountains, and attaching sticks to them throw them among the foliage of the trees, the sticks lodging in the branches and holding the caprifigs among the fruit.

The principle involved is very simple. The fig flower depends upon insects to fertilize it, as do a



"INTENSITY" MAGNET MADE BY HENRY IN 1829 TO DEMONSTRATE TELEGRAPHIC TRANSMISSION. PRINCETON UNIVERSITY MUSEUM.

number of others, among them being the orchid. The fig itself is a sort of a pot of seeds, and flowers, the flowers growing internally. In the Smyrna and in all other edible figs, the flowers are female, and do not secrete any pollen.

The caprifig is of a doubtful status. Some botanists regard it as the male tree of the fig, while others declare it is not only an entirely distinct species from any female fig-tree known, but the probabilities are that it is of a different genus. However this may be, its flowers are all male—that is, all of its flowers that the blastophaga permits to come to maturity. This fly enters the fruit when the latter is very small, and deposits its eggs in the flowers closest to the stem, filling the rows with eggs as high up as the center of the receptacle. When maturity is reached, the flies are ready to emerge, and the large end of the fruit being then slightly opened, they make their way out of the fig through that orifice.

When the insect passes up—or rather down—through the stamens of the male flowers, her hairy coat becomes loaded with the pollen which the anthers emit. With this she flies out, and, becoming herself ready to deposit, she seeks a new fig, and either entering it through a natural breech or boring her way in, she seeks the flowers in which to insert her eggs. Once in the fig the blastophaga never gets out, but dies there, and is eaten by the eater of the fig. One fly finds the cells in which it deposits none too numerous, for it lays about three thousand eggs.

This branch of the industry opens many important questions. Would different varieties of the caprifig impart to the edible fig different flavors? What varieties of the caprifig go with particular varieties of the edible fig, etc.? The trees are extremely hardy, and no horticultural industry in the State would be more profitable than fig raising if it could be made a success. There are about seventy-five known varieties of the caprifig. Only a few of these are in California. As rapidly as possible the flies are being acclimated, and they will be spread broadcast over the State, being placed upon ranches. By this means, if the colony in one part of the State should be destroyed, a new supply could be had.

The Scientific American Supplement.

Now that the subscriptions of many of our patrons are expiring, we wish to call attention to the advantages which our readers will secure by reading the Scientific American Supplement. This journal was founded in 1876, with a view to giving an opportunity for the publication of many long articles, working drawings, notes, sketches of travel and exploration, etc., which could find no place in the Scientific American proper, and while both these papers are entirely distinct, one is truly the complement of the other, and those who receive both papers can be assured of keeping in close touch with what is going on in the scientific world. The Supplement publishes each year 2,500 articles and notes varying in length from a few lines to many columns. These articles are illustrated each year by over 1,300 illustrations. One of the most valuable features of this unique periodical is the series of lectures and addresses which are given both at home and abroad. A stenographer with scientific training attends many of the most important lectures which are delivered in the United States, and makes careful stenographic reports exclusively for the Scientific American Supplement, which reports are in turn revised by the lecturers themselves, and, when necessary, are adequately illustrated from sources available only to the authors. These lectures are published weekly during the season, and in the present year no less than 140 addresses have been printed in the Supplement, many of them being illustrated. It should be remembered that there is a certain class of literature which does not get into book form for many years; we refer exactly to the kind of information which is given in these lectures. The professors and scientific men who give the lectures do not have time for book writing, and for this reason the value of these lectures, which represent their best thoughts and efforts, will be patent to all. The shorter notes are selected with particular reference to the needs of the readers of the Supplement and are on all subjects. A column of "Selected Formulæ" gives directions for making modern preparations of all kinds and is a most valuable feature. "Trade News and Notes" is a column of selections from German technical papers which are exclusively published in the Supplement. A page of Trade Suggestions from United States Consuls enables the readers of this paper to be kept informed of the condition and wants of trade all over the world, and the reports are published almost as soon as the daily "advance sheets" from which they are compiled. A specimen copy of the Supplement will be sent free on application to any of our readers who may be unfamiliar with this periodical, and those who have already subscribed to the Scientific American can obtain the Supplement at reduced rates by subscribing immediately.

Electric Railroad Cars in Belgium.

A series of tests have recently been carried out in Belgium in order to demonstrate the practicability of electrically-propelled cars on the railroad lines of that country. The tests have been carried out by the railroad administration on the lines radiating from Antwerp. There are at present five of these cars, which are of some length and carry 75 passengers, with first and second-class compartments. At each end of the car is a glass protected platform for the motorman. The accumulator system is used, and the car makes the distance from Antwerp to Brussels without recharging en route; the normal speed is 75 kilometers per hour. The cars are of an elegant pattern, and the construction is made as light as possible; they are divided into compartments by lateral partitions, according to the general European practice. These partitions are composed in the upper part of glass panes, so that the lighting of the car will be well distributed throughout. A powerful projector is carried in front, which illuminates the road for a distance of 150 meters. The administration, after a number of tests made under practical conditions, are satisfied with the system, and are preparing to double the number of cars in the near future.

The Westinghouse Company is constructing at their East Pittsburg shops a 1,500 horse power gas engine. It is 27 feet high, 12 feet 4 inches wide, and 44 feet long.

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A NEW ROTARY ENGINE.

An ingenious rotary engine, in which the steam is used expansively, has been patented by William F. James, of Phœnix, Arizona Territory.

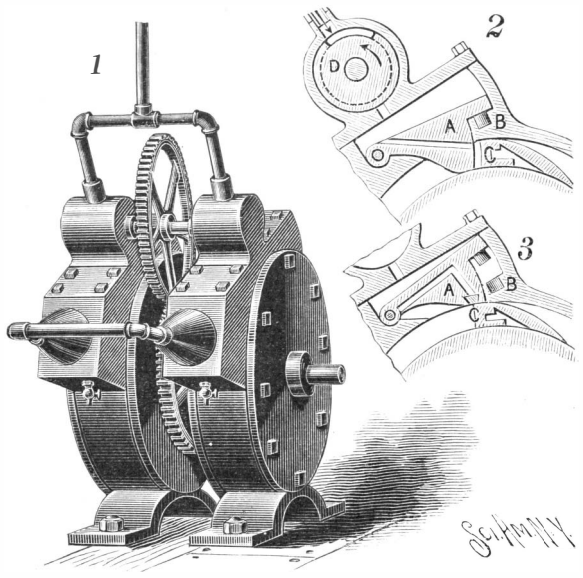
Fig. 1 of the accompanying illustrations is a perspective view of a compound engine; Fig. 2 is a cross-section, showing the cut-off valve and abutment; Fig. 3 is a detail section, showing the valve in a different position.

The cylinder casing is provided with two recesses, one of which serves as an exhaust-chest and the other of which receives the abutment. The piston upon which the abutment bears consists of a block, *C*, secured to the outer surface of the piston disk so as partly to close the steam space. Secured to the block, *C*, is an inclined plate resting on the piston disk. By placing packing plates between the inclined plate and the block, *C*, the depth of the piston in a radial direction may be regulated. The abutment, *A*, is hinged to the outer casing so as to swing up or down in obedience to the action of the rotating piston. The abutment is provided with an extension engaging the wall of the recess; the swinging movement of the abutment is therefore limited. By this means the disk is relieved of the pressure of the abutment without destroying the steam-tight contact. A steam port extends through the abutment and opens at the swinging end so as barely to clear the wall of the steam chamber. When the abutment is in the position shown in Fig. 2, steam is admitted through ports in the abutment recess. To avoid the jar due to the seating of the abutment upon the disk, a dash-pot is employed, entering a hole, *B*, in the casing.

In order to work the steam expansively, a rotary cut-off valve is employed, which is geared with the piston shaft. The gears are of such diameter that the valve and shaft rotate synchronously.

By providing the engine with two or more cylinders the pistons are placed oposite each other, so that there are no dead centers.

It is the inventor's intention to use his rotary engine in connection with a novel life-boat which he has patented and which we described in our issue of October 3, 1896.



JAMES' ROTARY ENGINE.

SOME OSTRICH STORIES.

The ostrich is a curious and remarkable bird, with its enormous body, long legs and small head. The experiences of the ostrich farmers, both in Africa and America, are most interesting, and there are tales without number of the strange antics of the curious birds. Naturally the first thought which occurs on seeing an ostrich is, How fast can it run? When feeding, the stride is only from 20 to 22 inches; when walking, but not feeding, the stride is 26 inches, but when terrified the bird possesses wonderful sprinting qualities and takes steps varying from 11½ to 14 feet. Taking 12 feet as the average, they would cover about 25 miles an hour, but the stories of birds traveling a mile a minute are open to question. Other traits of which we are always hearing is their lack of both suspicion and intelligence. Bushmen clothe themselves in one of their skins, and under cover of this go near enough to kill them with poisoned arrows.

When the bird considers that he has distanced his pursuer, he often puts his head in the sand, thinking he has thereby made himself invisible. Sometimes when hotly pursued he turns upon his enemies and gives severe wounds with his feet. The habits of ostriches are not particularly attractive. They eat fruits, game, vegetables, leaves, tender shoots, insects, snails and any other food that can be picked up, including all kinds of indigestible substances, which they swallow from stupid voracity. They are equally foolish about laying their eggs; they often begin before the spot has been fixed upon for the nest, and the solitary eggs are often found lying forsaken all over the district frequented by the ostrich. The nests are simply holes in the sand and vary from 3 to 6 feet in diameter. In these are laid by a single bird, or many in company, from twelve to fifty or sixty eggs. They are incubated by night and left to the heat of the sun during the day. The males assist in the incubation and also in taking care of the young until they can provide for themselves. When the ostrich chicks are as big as a common fowl, they run with great rapidity.

Europeans do not care for the taste of the ostrich eggs, but bushmen are very fond of them. They weigh from two to three pounds and are equal to twenty-four hen's eggs. The flesh somewhat resembles turkey, but is very tough. It will be remembered that the ostrich has been known from remote times, and their brains were served up as food on the tables of the Romans, and are referred to even in the book of Job.

Ostrich farming has already become a considerable industry in this country, as our readers will remember. Down in Florida, on an ostrich farm, there is an ostrich which acts as watchman, and woe betide the colored gentleman fond of taking fowls which do not belong to him. Such a person was nearly killed by this bird while he was attempting to steal some pheasants. This interesting bird, which has been dubbed "Napoleon," patrols the camp every little while, giving at intervals a cry which may be said to mean "All is well." If anything alarms him, he at once communicates it to his companions by a series of yells as he advances to the attack. The Brooklyn Eagle recently gave an interesting account of the method of procedure of this bird.

When fighting, the ostrich attacks his opponent with his feet with a series of lightning-like but terrific forward kicks. The power behind these efforts would make any government mule die with envy, and when it is known that the feet themselves are like ordinary railroad spikes, and ostriches have been known to disembowel a horse, it can be imagined what chance an unarmed person would stand in a fight. "Napoleon" stands nearly 10 feet high and weighs over 400 pounds. He is a bird of unusual intelligence, and during the day he is violent enough for ordinary purposes. At night, however, he becomes a true demon, and often his keeper is obliged to stand at a distance; and to see his keeper force "Napoleon" back to his pen every morning, with a large fork, is one of the sights of the ostrich farm. The enormous bird screeches with rage and strikes out with his feet, all the while slowly giving way.

One night those on the farm were awakened by a most terrific series of noises. Mingled with the roars of

THE OSTRICH AS A BEAST OF BURDEN.

"Napoleon" were the agonizing shrieks of a human being. Rushing to the pens, the cause was soon discovered. There, careening wildly, was a negro, and at his heels followed "Napoleon." The sight was laughable had it not been of a rather serious order. The ostrich would strike out and the negro would make a zigzag run. In the bright moonlight the negro's face was blanched white with the fear of death, and his cries for help moved even the hearts of the attendants to mercy. Finally the negro reached the fence and made an effort to get over but the bird with a final effort struck him, and if the blow had caught the negro squarely, it would undoubtedly have killed him. As it was the blow was a glancing one upon the thigh, which ripped it open and exposed the bone, and for a time it was thought the poor pheasant thief would bleed to death. The fame of this episode has naturally caused the pheasants' quarters to be shunned by other depredators, but notwithstanding this fact, "Napoleon" still keeps guard, and the colored folk of the neighborhood need not have any other lesson.

One of our California correspondents recently took a photographer to the South Pasadena ostrich farm, and after their views had been taken, it occurred to him that a picture of himself on a full-grown, native male ostrich would be interesting to the readers of the SCIENTIFIC AMERICAN. He requested an attendant to catch a bird and cover his head with a sack, which done he vaulted upon the creature. Immediately the photographer adjusted the camera and the attendant snatched the hood from the head of the bird, which immediately rushed away. The venturesome scribe slid safely to the ground after the first hundred yards had been traveled. History records the fact that the natives of Abyssinia frequently ride upon ostriches, but it is not likely that this amusement will become very popular on the ostrich farms of America.

Automobile News.

In Dakota thrashing engines have been used to haul several wagon loads of grain. As many as ten wagons can be transported with the aid of a powerful traction engine.

Fire Chief Croker, of New York city, has been using a steam automobile for going to fires. The results have been so very satisfactory that the use of motor vehicles will undoubtedly be considerably extended in the Department in the near future.

It is likely that automobiles will be shortly permitted to enter Druid Hill Park, Baltimore. The Park Commissioners recently took a ride in an electric vehicle to observe its effect upon the horses. They passed about 400 teams during their ride, and only about 2 per cent of the horses showed any fright, and even these were easily controlled by their drivers.

The Cycle and Automobile show will be held at Madison Square Garden during the week following January 20, 1900. Nearly all of the space, even in the galleries, has already been taken. In fact, it will be impossible to accommodate any more automobile concerns that may desire to exhibit heavy vehicles, for anything which is now given space must be light enough to be carried up on the balcony.

An automobile fire pump is being tested in Paris. The electric motors are operated by a storage battery, and it is arranged so that the power can be changed from the propulsion of the wagon to that of driving the pumps. The cost of operating an electric cab in Paris is, according to The Automobile, $3.97 a day. The calculation is based upon the supposition that the distance traveled per day is 37 miles, of which 9 are to and from the depot and 28 on the trips.

At Alençon, France, motor carriages are used for city ambulance work. The motor quadricycle is coupled to an ambulance carriage of the Lagogue pattern. Its purpose is to go to the succor of some injured person some distance from the town. The driver fetches the doctor and places him comfortably on the front seat of the motocycle. On arriving at his destination, the doctor immediately attends to the needs of the injured person. If necessary the patient is placed in the ambulance-carriage, and all return with all possible speed to the hospital.

The Current Supplement.

The current SUPPLEMENT, No. 1251, has many articles of unusual importance. "Long-Span Bridges" is the first installment of a valuable series forming an address by Prof. W. H. Burr, of Columbia University. It is fully illustrated. "The Highest Aim of the Physicist" is by Prof. Henry A. Rowland. "The Development of Iron Manufacture in the United States in the Past Seventy-five Years" is by John Fritz. "The Rapid Seasoning of Wood Through Electricity" is an illustrated article describing a new process. "New Method of Designing Fabrics" is a fully illustrated article dealing with Herr Jan Szczepanik's remarkable photographic process. It is accompanied by 40 engravings.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

TREE-FELLING DEVICE.—ELI BURKE, Tama, Iowa. The object of this invention is to produce a device for felling trees, which may be attached to a portable engine by which the necessary power is supplied. The inventor has mounted a swinging arm upon the engine, and upon this arm he has journaled a saw connected by suitable power-transmitting means with the engine and movable in any direction desired.

HOOD FOR CACTUS-BURNERS. — LEWIS W. SNOWDEN, Tilden, Tex. The hood is especially adapted for use on a cactus-burner, which concentrates the flame to any point desired and which can be securely held on the vaporizing coil or detached therefrom. The hood thoroughly protects the flame from wind, so that the concentration referred to can be easily effected. The peculiar formation of ribs on the hood, so that they engage the coil throughout its length, causes the hood to extend some distance beyond the lower end of the coil and forms a very hot furnace.

Mechanical Devices.

AUTOMATIC TYPESETTING.—DONALD MURRAY, 28 W. Eighth Street, Manhattan, New York city. This is an attachment for working a linotype, a typesetting machine, a typewriter, or any other keyboard machine automatically by means of a perforated paper tape. The invention's chief merits are that it uses ordinary half-inch telegraphic tape, perforated as for automatic telegraphy, and that it does not interfere with the ordinary operation of such machines by hand. It provides a method of rapidly and cheaply putting into type serial stories, special articles, telegraphic news distributed by syndicates and central news agencies to newspapers, the required number of tapes being perforated at one operation. The perforations being arranged in a straight line, can be transmitted by telegraph. In fact, the inventor has succeeded in perforating the tape by telegraph at a distance of 1,000 miles at the rate of 80 words per minute. A speed of 100 or 120 words over any telegraphic circuit will probably be reached. It will hence be possible to transmit newspaper dispatches and set them up simultaneously in type. This development is rendered practicable by the facility with which corrections and additions can be made as the work of typesetting proceeds.

RECORDING APPARATUS.—EDWIN C. HEGAN, Louisville, Ky. The invention provides a completely automatic apparatus arranged to furnish a full record in writing on a tape of all the telegraphic work during a given period, with the date and number of the circuit. The apparatus is especially applicable to district telegraph-offices, fire-alarm and police stations. The essential features of the apparatus are found in an actuating device for the numeral wheels, which comprises a lever operated by an electro-magnet and provided with a pin. Hooks on a series of bars are adapted to engage the pin. By means of a cam, the hooks of the bars are allowed to engage the pin, one at a time. The numeral wheels are turned from the bars when the latter are actuated.

MITER BOX.—THEODORE BOOTSMAN, Arctic, Wash. This invention is an improvement on a similar device patented by the inventor. The box is especially designed for locking saw-guides at different angles and for holding the guides at different elevations. In its essential features the invention comprises a support for the work, and a horizontally-swinging arm carrying saw-guides and held over the support. A vertically-swinging gage bar is arranged for locking engagement with the arm.

Railway-Appliances.

CAR-TRUCK.—ALEXANDER R. GREEN, Houston, Va. The invention seeks to overcome the friction between the car-wheels and the rails in rounding curves, due to the unequal length of the inner and outer rails. A coupling device is provided, the outside of which is attached to the car body and the inside to the frame of the guide truck and sliding freely with it under the car while controlling the rotary motion of the front and rear trucks. The axles are caused to assume the position of the radii being passed, while the wheel-flanges strike the rails on the tangent points of the curves.

Miscellaneous Inventions.

TEA-KETTLE.—WILLIAM MCAUSLAND, Taunton, Mass. The kettle is mounted on trunnion-bearings, open on both sides so that the kettle can be entirely removed, but is yet capable of being locked by a single locking bolt and a single adjustment. For this purpose the front trunnions have an upwardly-projecting and overhanging extension, which, when the bearings are open, allows the kettle to be removed, and yet locks the front bearings whenever the rear ones are locked.

FASTENING DEVICE FOR NECKWEAR.—EDWARD MCC. WICKERSHAM, Phœnix, Arizona. The invention provides a shield for made-up ties, which shield has means for fastening the made-up tie to a collar-button. The shield has a fastening device which may be employed in connection with a new tie, scarf, or bow after having been detached from the made-up tie to which it was originally secured. The entire device is very light, and when in use is invisible.

PUZZLE.—ALEXANDER H. KOPETSCHNY, Jersey City, N. J. Blocks bearing the words "knife," "plate," "fork," and "spoon," are indiscriminately shuffled, the object being to arrange them side by side, so that the four articles of tableware will appear to be named in each line, both vertically and crosswise, and the four articles of food pictured beneath the words will appear in each line, both vertically and crosswise.

BALL-BEARING.—FREDERICK H. HEATH, Hotel Gerard, Manhattan, New York city. The inventor makes the bearing self-adjusting to any spring of the shaft or permanent bend therein or vibrations from unequal strains, by providing a spherical inner surface which is presented to the balls, so that if the axle or shaft spring or be bent, the balls will still travel in the same circular track, whereby the wedging of the balls is entirely obviated and an equal and even bearing on all the balls always maintained, thus adding greatly to the smooth running and life of the bearings.

APPARATUS FOR MAKING PHOSPHORUS.—LOUIS L. BILLAUDOT, Avenue Victoria 16, Paris, France. In order to overcome the objections to the use of water in condensing phosphorus gases, the inventor receives the mixture of vaporous phosphorus and gases in receptacles of sufficient surface for the cooling processes and large enough to give the condensed particles of phosphorus time enough to deposit on the inner walls, the deposition being assisted by the special shape of the receptacles, which have baffle boards to give different speeds to the gaseous current. In order to gather the condensed phosphorus, the dry mixture of phosphorus and foreign materials is then distilled in the same receptacle or other receptacles.

DRAFT-EQUALIZER.—FRANK F. THILL, Wheaton, Minn. The draft-equalizer is especially applicable to harvesters or mowing machines, and by its means three horses may be worked at the right-hand side of the pole and a fourth horse at the left-hand or grain side of the pole. On an extension from the right-hand side of the pole an equalizing-bar is pivoted. A fulcrum-bar is pivoted between its center and right-hand end on the tongue or pole; the longer portion of the fulcrum-bar extends beyond the left-hand side of the tongue. Straps connect the shorter end of the fulcrum-bar with the pivot portion of the equalizing-bar. A double-tree is directly connected with the equalizing-bar at its right-hand end; and a second double-tree is located at the left-hand end. Straps connect the left-hand double-tree with the fulcrum-bar and with the equalizing bar. The left-hand ends of the equalizing and fulcrum-bars are also connected.

COPYING-PRESS.—WALTER THEXTON, Duluth, Minn. The press comprises a bed-plate circularly formed on its top. A cushion is placed over the bed plate, over which a removable cover is fitted. An apron moves into and out of a water-tank rearward of the bed-plate. A pressing-roller is movable over the bed-plate and is operated by a treadle. The leaves of the copy-book are dampened before the impression is taken and the second leaf is moistened while the first is taking the impression.

ACETYLENE GENERATOR.—HENRY P. SCHAEFER, Schulenburg, Tex. The purpose of this invention is to provide a machine, so arranged as to prevent the entrance of air or the escape of gas when the carbid holder is removed for cleaning. The apparatus comprises a gas-generating cylinder connected by a pipe with a receiver. A bucket or carbid-holder is removably connected with the lower end of the cylinder. A chute leads into the cylinder; and a valve controls communication between the chute and the cylinder.

APPARATUS FOR CRYSTALLIZING SUGAR IN MOTION.—EDWARD P. EASTWICK, Jr., New Orleans, La. An air-valve is provided for the crystallizing cylinder, which valve can be manually or automatically operated. When operated automatically, an excess of pressure or a vacuum is prevented in the crystallizing-cylinder; when operated manually, the opening uncovered can be utilized to take from the cylinder samples of the masse-cuite in process of crystallization. Besides this improvement, a better driving mechanism is provided, likewise a preferred construction for the interior of the cylinder, and a heating device for the cylinder.

WAREHOUSE-TRUCK.—JOHN B. DOYLE, Stampley, Miss. This warehouse or railroad-truck has in addition to the usual wheels and axle, wheels of smaller diameter also mounted on the axle, one adjacent to the inner face of each of the main wheels. The inner wheels can be spaced so that the truck can be used on a plank or staging of slightly less width than the distance between the inner faces of the main wheels, and carried up or down the staging, and automatically guided. The outer and larger wheels serve as guide flanges when the smaller wheels are brought into action.

CARBURETER.—WILLIAM E. CARY, Springfield, Vt. Within the carbureter-tank is a float carrying an air-pipe having air-inlets and gas-mixture outlets. A nozzle in the pipe opens at its lower end to the liquid and extends at its upper end above the inlets in the pipe. As the pipe carried by the float has an easy sliding fit in an outlet-pipe, the float rises and falls with the liquid in the tank. The float can be forced with more or less power down into the liquid by means of an adjustable, weighted, needle-valve stem. The carbureter is particularly adapted for explosion engines.

METALLIC PACKING.—WILLIAM H. PRENDERGAST, Savannah, Ga. The inventor has devised a metallic packing-case for piston-rods, which is used in connection with a packing having a ball-joint or spherical bearing surface whereby it is adapted to rock to compensate for vibration or displacement of the piston-rods.

COMBINED FIRE-ESCAPE AND ALARM.—VALENTINE and EDWARD V. SCHIRMER, 300 West 70th Street, Manhattan, New York city. The invention provides a fire-escape employing a flexible ladder, which is hung from a building for the escape of the occupants, and which is strong enough to support forty persons at a time. The ladder can be instantly released and will cover every window on a 25-foot front building. The invention also embodies a simple means for sounding an alarm in any place in the building at the instant the ladder is released, so that all the occupants are warned of their danger. The fire-escape, when not in use, is invisible. The simplicity of the construction renders it impossible for the device to get out of order.

FIRE-ESCAPE.—HENRY C. KARPENSTEIN, Brooklyn, New York city. The fire-escape ladder is designed to be placed on the outer side of a building and is provided with a simple means for holding the ladder in its elevated or inoperative position. The holding mechanism can be quickly released, so that the ladder will fall by gravity to the ground or other landing place to permit the safe descent of persons.

Designs.

MANDOLIN-BODY.—WALTER H. SMAW, Brooklyn, New York city. The body is flat and has arms extending from its upper end and flanking the neck. The inventor states that the advantage of this construction lies in the more beautiful tone obtained.

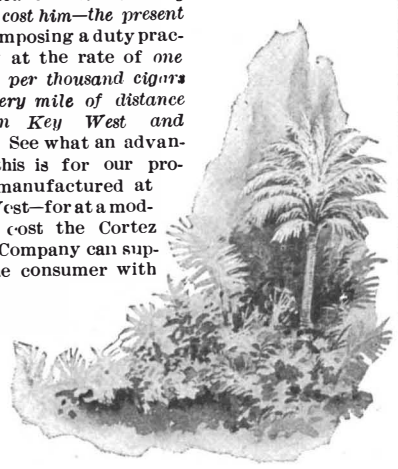
WALL-PAPER.—HENRY WEARNE, Rixheim, Alsace, Germany. Six design patents have been granted to this inventor for wall-paper of various patterns. The designs are noteworthy for a felicitous combination of different kinds of flowers, by means of which a very artistic effect is produced.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Key West

ALTHOUGH "many men have many minds," the verdict of the whole civilized world is a unit in the answer that a good cigar is the product of the finest soil of Cuba, known as the Vuelta Abajo, or Valley of the Willow Bough, manufactured by natives (who have grown up in the industry) in the self-same climate where the raw material is grown.

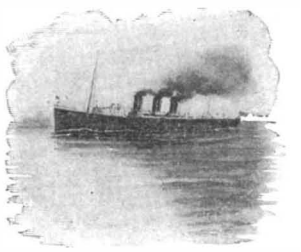
That is to say, that Vuelta tobacco manufactured in the latitude 19° 50′ to 23° 9′ and in longitude 74° 8′ to 84° 58′ by experts who may be said to have grown up in the industry, experienced in the most expert treatment from seed-bed to consumer, gives the finest cigar that the world and human skill can produce! That being granted beyond dispute, the most favorable place in the world for making cigars for American smokers is Key West, in the same latitude and longitude as Havana, from which city it is only eighty-eight miles distant. This is because the cigars made in Key West *cost the consumer only about one-half what the same identical cigar made in Havana and imported to this country would cost him—the present tariff* imposing a duty practically at the rate of *one dollar per thousand cigars for every mile of distance between Key West and Cuba*. See what an advantage this is for our product, manufactured at Key West—for at a moderate cost the Cortez Cigar Company can supply the consumer with goods equal in quality, style, and workmanship to those of most celebrated Havana cigar factories.



Key West is unique in location, buildings, population, and climate. The coldest month is January, and the temperature is as an average of 68 degrees to 72 degrees, while statistics show that it is the *only point in this country where snow and frosts are unknown*, and this secures the ideal climate for cigar making. This is because it is not necessary to use in the Cortez Cigar Company's factory any artificial moistening or sweating process, thus retaining the full aroma and bouquet (which is so dear to every smoker) to just the same extent as in the Havana factories. *This cannot be done in factories further north!* And herein lies the great advantage of Key West.

Knowing all these important facts, the Cortez Cigar Company selected this city for the location of their factory, determined to produce only high-grade cigars, equal in every way to those of Havana, at about one-half the cost to the consumer! This product is always the same in quality. Year after year the Cortez Cigar Company use the same grade of tobacco grown on the same plantations, and by skillful blending of the selected leaves from the hill-sides and valleys, secure a uniformity which cannot be surpassed.

There is a reason for everything, and the reason of the Cortez Cigar Company for devoting their energies to the production of a fine cigar is because they believe and insist that the highest civilization demands the lightest and most perfect stimulant, and they believe that their process results in the combination of the highest possible art and science of cigar-making, enabling them to offer the best, mildest, and most uniform smoke to men of brains.



To meet the taste of various smokers, the Cortez Cigar Company make no less than fifty-two sizes of cigars, from large to small—for some like a long smoke and some a short one; but the quality is identical in each, and a man does not get a poorer cigar for a lower price, but simply so much less of the one high grade of uniform quality. It must not, however, be overlooked that the fullest flavor and bouquet can only be reached with a cigar of a medium to a full size. It is like the use of a perfume—a drop will not convey the same fragrance as will the orthodox half-dozen drops, yet it will be the same identical perfume without change. The cigars of the Cortez Cigar Company may always be identified by the reproduction of the cut on the inside back of each box. It is our aim to have our cigars on sale wherever high-grade goods are demanded, and should your local dealer offer you "something just as good," decline it, and write direct to the Cortez Cigar Company, Key West, for samples and particulars.

Business and Personal.

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Notes & Queries

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Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated: correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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Scientific American Supplements referred to may be had at the office. Price 10 cents each.

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Minerals sent for examination should be distinctly marked or labeled.

(7773) J. H. P. asks: 1. How are the telephones on a metallic circuit connected so that the telephones between the terminal telephones do not short circuit the terminal telephones? A. The intermediate telephones are put across the two wires of the circuit. A telephone does not short circuit the other telephones upon the same line because it is not in circuit except when it is in use, and then it should have the line to itself. 2. Which is the best system, the bridge system or in series? A. The "bridging bell" system is in use for all long-distance work. It allows a large number of telephones to be used upon the same line. 3. Explain wiring of bridge system? A. Both the call bell and the telephone are put across the line. You will find diagrams of the connections in books upon the telephone. We can furnish you Hopkins' "Telephone Lines" for $1.50 by mail, and Miller's "American Telephone Practice" for $2 by mail. The call-bell is wound to a high resistance, say 1,000 ohms, and therefore cannot short-circuit the other portions of the line. 4. When speaking of the number of ohms resistance of a telephone what is meant, ringer, generator, or induction coil? A. If the resistance of a telephone is given, it should be that of the telephone, or receiver. That is the telephone. The other parts of the apparatus have their special names. 5. Does the winding of more wire on the generator increase its power? If it does, how much wire must I put on to ring through 100 more ohms of resistance? A. You may wind more wire on the armature of the magneto-call, and make it ring through a greater resistance. Of course we cannot tell you how much to add to make the bell ring through 100 ohms more resistance, since we know nothing about what is already there, either on the line or the magneto. You would better find out by experiment, if you cannot measure for yourself.

(7774) E. K. A. asks: Is the rate of rotation of the wheel of a Crookes radiometer proportional to the amount of radiant energy impinging upon the surfaces? A. Yes; see Barker's "Physics" or Ganot's "Physics."

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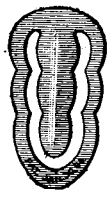

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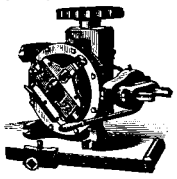

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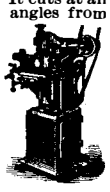

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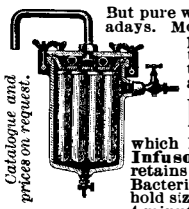

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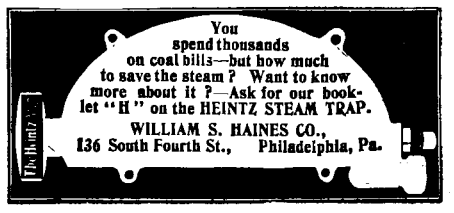
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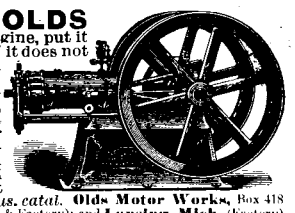

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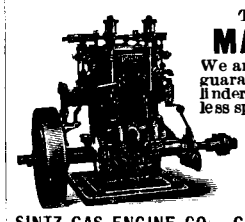

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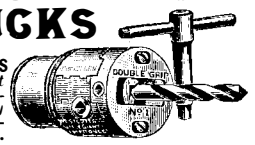

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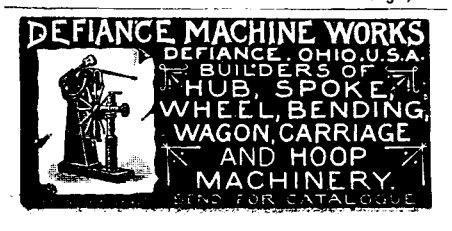
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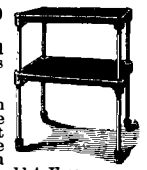

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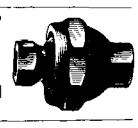

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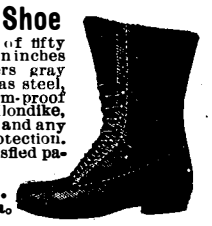

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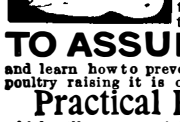

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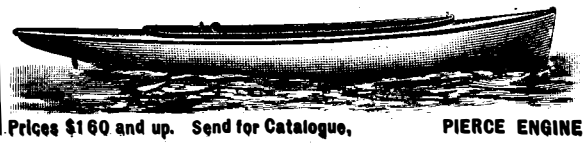

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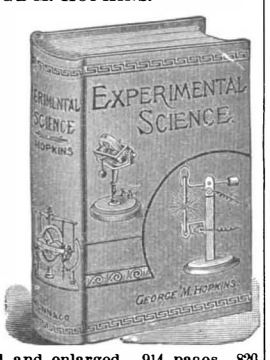

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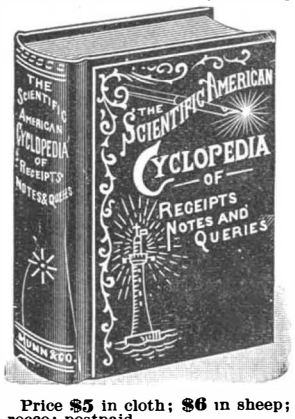

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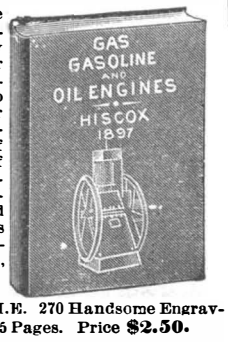

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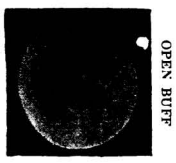
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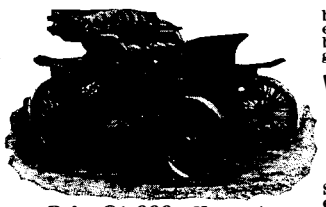

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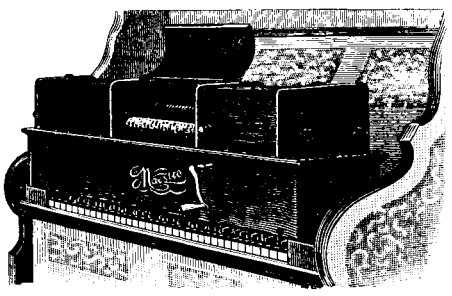

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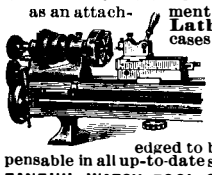

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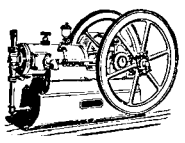

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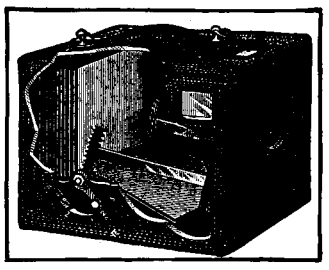

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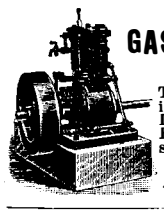

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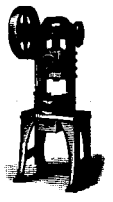

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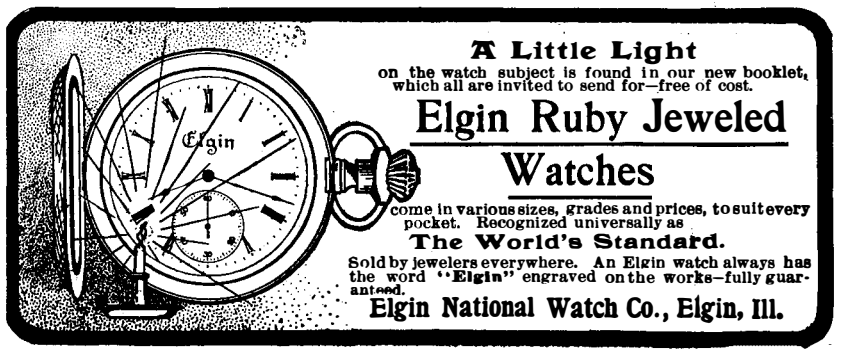

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